Scientific and Technical Aerospace Reports

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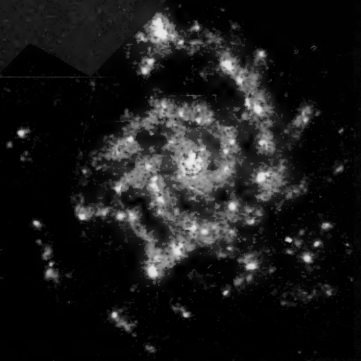

An Abstract Journal

Volume 30, Number 15
August 8, 1992
N92-24071 to N92-25145

Scientific and Technical Aerospace Reports

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Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

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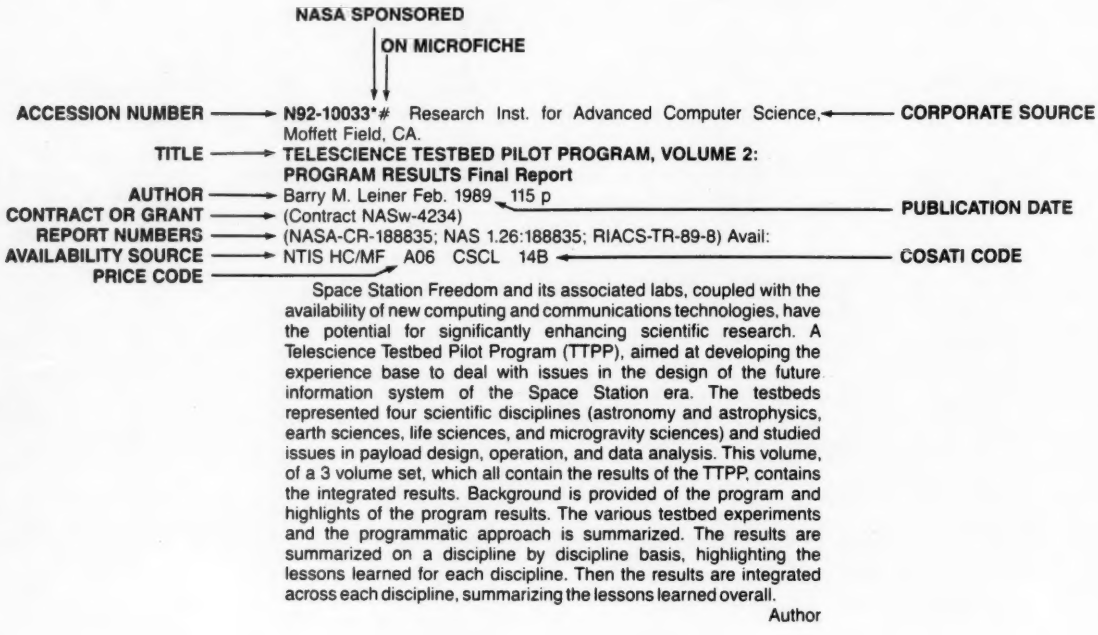
TYPICAL CITATION AND ABSTRACT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ACCESSION NUMBER
N92-10033*# Research Inst. for Advanced Computer Science, Moffett Field, CA.
CORPORATE SOURCE
TITLE
TELESCIENCE TESTBED PILOT PROGRAM, VOLUME 2: PROGRAM RESULTS Final Report
AUTHOR
Barry M. Leiner Feb. 1989 115 p
PUBLICATION DATE
CONTRACT OR GRANT
(Contract NASw-4234)
REPORT NUMBERS
(NASA-CR-188835; NAS 1.26:188835; RIACS-TR-89-8) Avail:
AVAILABILITY SOURCE
NTIS HC/MF A06 CSCL 14B
COSATI CODE
PRICE CODE
Space Station Freedom and its associated labs, coupled with the availability of new computing and communications technologies, have the potential for significantly enhancing scientific research. A Telescience Testbed Pilot Program (TTPP), aimed at developing the experience base to deal with issues in the design of the future information system of the Space Station era. The testbeds represented four scientific disciplines (astronomy and astrophysics, earth sciences, life sciences, and microgravity sciences) and studied issues in payload design, operation, and data analysis. This volume, of a 3 volume set, which all contain the results of the TTPP, contains the integrated results. Background is provided of the program and highlights of the program results. The various testbed experiments and the programmatic approach is summarized. The results are summarized on a discipline by discipline basis, highlighting the lessons learned for each discipline. Then the results are integrated across each discipline, summarizing the lessons learned overall.
Author

VOLUME 30 NUMBER 15 / AUGUST 8, 1992

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N92-24678*# National Aeronautics and Space Administration, Washington, DC.
NASA AERODYNAMICS PROGRAM Annual Report, 1991
Louis J. Williams, Kristin A. Hessenius, Victor R. Corsiglia, Gary Hicks, Pamela F. Richardson, George Unger, Benjamin Neumann, and Jim Moss Apr. 1992 245 p
(Contract NASw-4430)
(NASA-TM-4368; NAS 1.15:4368) Avail: NTIS HC/MF A11 CSCL 01B

The annual accomplishments is reviewed for the Aerodynamics Division during FY 1991. The program includes both fundamental and applied research directed at the full spectrum of aerospace vehicles, from rotorcraft to planetary entry probes. A comprehensive review is presented of the following aerodynamics elements: computational methods and applications; CFD validation; transition and turbulence physics; numerical aerodynamic simulation; test techniques and instrumentation; configuration aerodynamics; aeroacoustics; aerothermodynamics; hypersonics; subsonics; fighter/attack aircraft and rotorcraft. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N92-24229*# Eloret Corp., Sunnyvale, CA.
DEVELOPMENT AND APPLICATION OF COMPUTATIONAL AEROTHERMODYNAMICS FLOWFIELD COMPUTER CODES Progress Report, 1 Oct. 1991 - 31 Mar. 1992
Ethiraj Venkatapathy 7 May 1992 146 p Original contains color illustrations
(NASA-CR-190294; NAS 1.26:190294) Avail: NTIS HC/MF A07; 5 functional color pages CSCL 01A

Presented is a collection of papers on research activities carried out during the funding period of October 1991 to March 1992. Topics covered include: blunt body flows in thermochemical equilibrium; thermochemical relaxation in high enthalpy nozzle flow; single expansion ramp nozzle simulations; lunar return aerobraking; line boundary problem for three dimensional grids; and unsteady shock induced combustion. H.A.

N92-24680*# Maryland Univ., College Park.
A STUDY OF VISCOUS INTERACTION EFFECTS ON HYPERSONIC WAVERIDERS Ph.D. Thesis, Dec. 1991
Jinhwa Chang Mar. 1992 216 p
(Grant NAG1-1192)
(NASA-CR-189587; NAS 1.26:189587; UM-Aero-91-44) Avail: NTIS HC/MF A10 CSCL 01A

The effects of viscous interaction in the analysis and design of improved classes of viscous optimized hypersonic waveriders is examined. The Corda computer program is used to generate viscous optimized hypersonic waveriders from conical flow fields without viscous interaction. Each waverider is optimized for maximum L/D, and comparison studies are made between cases with and without viscous interaction. The results show that aerodynamic performance of the viscous interaction waveriders are reduced due mainly to a large increase in skin-friction drag associated with the viscous interaction phenomena that grows with increasing Mach number and altitude, but some of this performance loss can be recouped by including viscous interactions within the optimization procedure. When the waverider is optimized for viscous interaction, the shape can change dramatically. A significant result of the present work delineates on a velocity-altitude map the region where viscous interaction effects are significant for modern hypersonic waveriders by performing parametric runs to produce L/D, C sub L, and C sub D contour plots for Mach numbers from 6 to 30 at altitudes from 30 to 80 km. Author

N92-24681*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN INCREMENTAL STRATEGY FOR CALCULATING CONSISTENT DISCRETE CFD SENSITIVITY DERIVATIVES
Vamshi Mohan Korivi, Arthur C. Taylor, III, Perry A. Newman, Gene W. Hou (Old Dominion Univ., Norfolk, VA.), and Henry E. Jones Feb. 1992 34 p
(NASA-TM-104207; NAS 1.15:104207; AVSCOM-TR-92-B-006)
Avail: NTIS HC/MF A03 CSCL 01A

In this preliminary study involving advanced computational fluid dynamic (CFD) codes, an incremental formulation, also known as the 'delta' or 'correction' form, is presented for solving the very large sparse systems of linear equations which are associated with aerodynamic sensitivity analysis. For typical problems in 2D, a direct solution method can be applied to these linear equations which are associated with aerodynamic sensitivity analysis. For typical problems in 2D, a direct solution method can be applied to these linear equations in either the standard or the incremental form, in which case the two are equivalent. Iterative methods appear to be needed for future 3D applications; however, because direct solver methods require much more computer memory than is currently available. Iterative methods for solving these equations in the standard form result in certain difficulties, such as ill-conditioning of the coefficient matrix, which can be overcome when these equations are cast in the incremental form; these and other benefits are discussed. The methodology is successfully implemented and tested in 2D using an upwind, cell-centered, finite volume formulation applied to the thin-layer Navier-Stokes equations. Results are presented for two laminar sample problems: (1) transonic flow through a double-throat nozzle; and (2) flow over an isolated airfoil. Author

N92-24803*# California Polytechnic State Univ., San Luis Obispo.
A STUDY OF TRANSONIC AERODYNAMIC ANALYSIS METHODS FOR USE WITH A HYPERSONIC AIRCRAFT SYNTHESIS CODE
Doral R. Sandlin and Paul Christopher Davis May 1992 122 p Original contains color illustrations
(Contract NCC2-660)
(NASA-CR-189854; NAS 1.26:189854) Avail: NTIS HC/MF A06; 10 functional color pages CSCL 01A

A means of performing routine transonic lift, drag, and moment

analyses on hypersonic all-body and wing-body configurations were studied. The analysis method is to be used in conjunction with the Hypersonic Vehicle Optimization Code (HAVOC). A review of existing techniques is presented, after which three methods, chosen to represent a spectrum of capabilities, are tested and the results are compared with experimental data. The three methods consist of a wave drag code, a full potential code, and a Navier-Stokes code. The wave drag code, representing the empirical approach, has very fast CPU times, but very limited and sporadic results. The full potential code provides results which compare favorably to the wind tunnel data, but with a dramatic increase in computational time. Even more extreme is the Navier-Stokes code, which provides the most favorable and complete results, but with a very large turnaround time. The full potential code, TRANAIR, is used for additional analyses, because of the superior results it can provide over empirical and semi-empirical methods, and because of its automated grid generation. TRANAIR analyses include an all body hypersonic cruise configuration and an oblique flying wing supersonic transport. Author

N92-24849# Canadian Aeronautics and Space Inst., Montreal (Quebec). Aerodynamics Section.

PROCEEDINGS OF THE 3RD CANADIAN SYMPOSIUM ON AERODYNAMICS

1991 461 p Symposium held in Toronto, Ontario, 20-21 Nov. 1991 Prepared in cooperation with National Research Council of Canada, Ottawa, Ontario

(CTN-92-60420) Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

The CASI Symposium on Aerodynamics was organized to provide a forum for aerodynamics specialists to meet, exchange ideas, and present their latest works. Major topics covered include: (1) computational fluid dynamics, (2) experimental aerodynamics, (3) aeroelastics, and (4) operational issues related to the aircraft design, aerodynamic performance, aerodynamic analysis, and experimental measurements of aerodynamic properties especially as they relate to aircraft design. For individual titles, see N92-24850 through N92-24877.

N92-24850# Ecole Polytechnique, Montreal (Quebec). Groupe de Recherche MIAO.

PERIODIC EULER AND NAVIER-STOKES SOLUTIONS ABOUT OSCILLATING AIRFOILS

J. Y. Trepanier, H. Zhang, M. Reggio, and M. Paraschivoiu *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 2-12 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

A methodology for solving the unsteady Euler and Navier-Stokes equations around oscillating airfoils is presented. The procedure is composed of a moving grid management algorithm and of a Lagrangian-Eularian flow solver. Triangular elements have been used to achieve flexible grid movement and adaptation. The scheme for moving grids uses a generalized version of the approximate Riemann solver of Roe which satisfies in an intrinsic way the geometric conversion laws and on which a novel manner to add the viscous terms has been implemented. The methodology has been applied to simulate the flow around an oscillating NACA0012 airfoil. The method was shown to be well adapted to these computations, especially in the Euler case where grid adaptation resulted in a better resolution of the moving shock wave. Author (CISTI)

N92-24851# Defence Research Establishment Valcartier (Quebec).

NSWC/DREV 3-D EXPLICIT PARABOLIZED NAVIER-STOKES CODE

J. R. Evans, A. B. Wardlaw, and S. F. Davis, Jr. (Naval Research Establishment, Valcartier, Quebec) *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 13-29 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

A 3D parabolized Navier-Stokes (PNS) algorithm has been developed for the prediction of steady supersonic missile aerodynamics. The scheme solves the PNS (or Euler if desired) equations using an explicit, finite-volume Godunov approach. Inviscid flux components between cells are evaluated by solving an approximate Riemann problem at each cell-cell interface using Roe-average coefficients to preserve discontinuities. Smoothing of spatial derivatives is accomplished by limiting the Riemann invariants. The method uses generalized transformed coordinates with a clustering algorithm which dynamically adjusts the grid to achieve a prescribed Mach number at a given point near the wall. A sublayer acceleration technique was used to give a five-fold run-time reduction over a normal explicit stepsize limited scheme. This paper describes the algorithm and compares results against experimental and computational fluid dynamics generated data for the following test cases: Mach 2 laminar flat plate, Mach 14 compression corner, supersonic missile body at high incidence, tubular projectile, and a Mach 7.95, alpha=24 deg cone. Results from PNS-3D code were in good agreement with the data and the scheme is robust. Author (CISTI)

N92-24852# Defence Research Establishment Valcartier (Quebec).

SOME APPLICATIONS OF A NAVIER-STOKES CODE TO PROBLEMS IN EXTERNAL BALLISTICS

F. Lesage and M. J. Raw (Advanced Scientific Computing Ltd., Waterloo, Ontario) *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 30-44 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

This paper presents Navier-Stokes computational fluid dynamic solutions to four problems representing a wide range of Mach numbers, geometry complexities and viscous effects: (1) the separation of a sabot from a kinetic energy projectile, (2) a blunt projectile at Mach 7, (3) a tubular projectile at Mach 4.38, and (4) a finned submunition at Mach 0.9 and 90 deg angle of attack. They were used to evaluate the performance of the commercially available TASCflow (TM) Navier-Stokes code on viscous effects. For each problem, the strengths and weaknesses of the numerical method used are given with consideration to grid generation, robustness of the flow solver, robustness of the turbulence model, quality of the results (comparison to experimental data), and human and computer resources required. The application of the TASCflow code to these problems showed the importance of viscous effects in such flowfields. Furthermore, the code proved to be successful in solving problems at Mach 4 and above. Although grids were coarse because calculations were done on workstation class machines, results showed qualitative and in some cases quantitative accuracy. Some deficiencies were noted, such as the robustness of the discretization schemes for strong normal shocks and the robustness and accuracy of the turbulence model for some applications. Author (CISTI)

N92-24853# Ecole Polytechnique, Montreal (Quebec). Dept. of Mechanical Engineering.

NAVIER-STOKES SIMULATION OF DYNAMIC STALL ON A ROTATING AIRFOIL

Ko-Foa Tchon and Ion Paraschivoiu *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 45-56 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

In the present paper, the incompressible unsteady isothermal viscous flowfield around a moving airfoil is modeled by the two-dimensional time averaged Navier-Stokes equations expressed in a stream function - vorticity formulation and in a non-inertial frame of reference. Spatial discretization is achieved by the streamline upwind/Petrov-Galerkin finite element method. Temporal discretization is achieved by second order accurate finite differences. At each time step, a non-linear algebraic system is

solved using a Newton method. To accelerate the computations, a fast conjugate gradient method with an incomplete triangular factorization preconditioning is used to solve the linearized Newton systems. The computational mesh is composed of a structured region of highly stretched quadrilateral elements in the vicinity of solid boundaries, an unstructured region of triangular elements elsewhere, and a layer of infinite elements surrounding the domain and projecting the external boudary to infinity. Preliminary computations were performed on a circular cylinder and a NACA 0018 airfoil in translation and rotation. Author (CISTI)

N92-24854# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

TVD FINITE-DIFFERENCE SOLUTIONS OF NONEQUILIBRIUM VIBRATIONALLY RELAXING AND CHEMICALLY REACTING GASEOUS FLOWS

C. P. T. Groth and J. J. Gottlieb *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 57-80 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Partially decoupled total variation diminishing (TVD) finite difference schemes for the solution of the conservation laws governing two dimensional nonequilibrium vibrationally relaxing and chemically reacting flows of thermally perfect gaseous mixtures are presented. In these methods, the gas dynamic and the thermodynamic equations are partially decoupled by using a frozen flow approximation. Both sets of decoupled equations are then solved alternately in a lagged manner within a time marching procedure, thereby providing explicit coupling between the fluid conservation laws and the species concentration and vibrational energy equations. Both time-split semi-implicit and factored implicit flux-limited TVD upwind schemes are described. The semi-implicit formulation is more appropriate for unsteady applications whereas the factored implicit form is useful for obtaining steady-state solutions. Extensions of Roe's approximate Riemann solvers, giving the eigenvalues and eigenvectors of the fully coupled systems, are used to evaluate the numerical flux functions. Additional modifications to the Riemann solutions are also described which ensure that the schemes are entropy satisfying. The proposed partially decoupled methods are shown to have several computational advantages over other loosely coupled and fully coupled techniques. Furthermore, numerical results for single, complex, and double Mach reflection flows, as well as corner expansion and blunt-body flows, using a five-species four temperature model for air demonstrate that the methods perform well over the entire thermodynamic regime, from equilibrium to nonequilibrium conditions on through to the frozen flow limit. Author (CISTI)

N92-24855# Defence Research Establishment Valcartier (Quebec). Armaments Div.

THE DREV AEROBALLISTIC RANGE

Alain Dupuis *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 81-93 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

During the last ten years, the Defence Research Establishment Valcartier, Quebec, has been renovating their free-flight aeroballistic range to an orthogonal camera shadowgraph system to obtain aerodynamic characteristic and stability derivatives for both spin and fin stabilized projectiles. The main features of the range and the installed instrumentation are given as well as the data reduction system. The trajectory of the projectile is extracted using a shadowgraph system. Determination of the aerodynamic coefficients and stability derivatives is the primary goal of analyzing free-flight trajectories. The data reduction process is carried out by an interactive software system (BARDAS) which is capable of a complete linear theory analysis and a six degree of freedom analysis. A number of aluminum spheres were fired in the range at Mach 7 to test the instrumentation. Initial results were very promising and all instrumentation and software functioned as expected. A series of dart models with various surface roughnesses were recently fired to obtain more aerodynamic coefficients and were also successful. The calibration system has been simulated and tested with success. Author (CISTI)

N92-24856# National Research Council of Canada, Ottawa (Ontario). Inst. for Aerospace Research.

AN ANALYSIS OF THE SIDEWALL BOUNDARY LAYER EFFECT IN TWO-DIMENSIONAL WIND TUNNEL TESTING

D. J. Jones and Y. Y. Chan *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 94-106 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

The Institute for Aerospace Research 1.5 m by 1.5 m wind tunnel is operated in a 2D mode with a 0.38 m wide insert in the working section usually giving a width to chord ratio of about 1.5. Although sidewall boundary layer effects are alleviated to some extent by allowing for controlled suction on the walls surrounding the airfoil, it is shown in the present paper that a residual effect is still experienced in such a narrow facility. By carrying out a numerical analysis of the phenomena using an inviscid wing code coupled with a small crossflow boundary layer method, suggestions are made to overcome the sidewall boundary layer problem. The major sidewall interference remaining after applying suction appeared to come from the airfoil leading edge/sidewall interaction which caused the sidewall boundary layer to thin extensively as it approaches the airfoil. To achieve better 2D flow, small endplates will be fixed on the airfoil model at a spanwise location just far enough from the sidewalls to be outside the sidewall boundary layer. This arrangement should result in good 2D flow. Author (CISTI)

N92-24857# De Havilland Aircraft Co. of Canada Ltd., Ottawa (Ontario).

VORVISC: A VORTEX LATTICE METHOD WITH VISCOUS AND COMPRESSIBILITY CORRECTIONS FOR FULL AIRCRAFT CONFIGURATIONS INCLUDING PROPULSION

G. C. Waller *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 125-142 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

VORVISC was written to fulfill a need for an early project design tool which could be used to rapidly predict the basic aerodynamics of a new configuration given basic geometry only. A vortex lattice based code was employed, as the method is robust and representation of through flow effects such as intakes or boundary layers was not required. The code has been validated against isolated propellor performance data, 2D supercritical wing pressure distributions and propeller/wing interaction tests. VORVISC has been used in project applications such as inboard wing design, wind tunnel correction estimation and flowfield prediction for a flapped wing. Author (CISTI)

N92-24858# University of Western Ontario, London.

LAMINAR-TURBULENT TRANSITION PROCESS IN THE PRESENCE OF SIMULATED WALL ROUGHNESS

J. M. Floryan, K. Yamamoto, and T. Murase (Fujitsu Ltd., Tokyo, Japan) *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 143-155 (For primary document see N92-24849 15-02)

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Understanding how surface roughness affects the laminar turbulent transition process is of particular interest in Laminar Flow Control (LFC) wing design, where stability characteristics of boundary layers with and without surface roughness are being sought. The importance of roughness shows in favourable pressure gradient laminar airfoils, where roughness is the primary agent which renders them nonlaminar in practice. Investigation of the laminar turbulent transition process in plane Poiseuille flow in the presence of distributed surface roughness has been carried out.

Wall roughness has been simulated by application of a fixed wall suction/blowing in order to enable direct numerical simulation of the transition process using Fourier spectral methods. Analysis has been focused on the wall suction in the form of a single sinusoidal wave. This suction, which represents external forces applied to the flow, produced disturbances at the wall in the form of two dimensional ridges. It has been demonstrated that the presence of such disturbances can induce the laminar turbulent transition process even in cases that are completely stable when the wall is smooth. The character of the flow evolution strongly depends on the relative location of the suction parameters and the spectrum of the natural response of the flow in the parameter space. Unsteadiness of the basic state was observed to occur at much lower suction amplitudes when the suction wavenumber corresponded to the unstable range in the natural spectrum. The transition process induced by the suction was in all cases dominated by linear instability of the new (suction) modified flow.
Author (CISTI)

N92-24859# Bombardier, Inc., Montreal (Quebec).
ON THE COUPLING OF EULER/BOUNDARY-LAYER EQUATIONS
Farzad Mokhtarian *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 157-171 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

A viscous/inviscid interaction scheme is implemented for a modified version of the FLO67 Euler code of Jameson for wing-body calculations. The FLO67 solver uses an internally generated C-grid for wing configurations which can be modified externally and used for wing-body calculations. The solver uses multi-gridding and enthalpy damping to accelerate convergence. Wing viscous effects (friction drag, displacement or transpiration surface) are computed in the method by coupling a modified Bradshaw boundary layer computation with the above finite volume Euler scheme. The laminar boundary layer is predicted by Thwaites method modified for compressible flow. The modified chord technique of Nash and Tseng is used. This technique permits a two dimensional boundary layer method to be extended to the three dimensional case provided that the flow does not deviate far from the infinite sheared wing type. This quasi three dimensional approach has been selected because it requires about an order of magnitude less computing time than a full three dimensional boundary layer calculation. The viscous/inviscid results of the above method are thus correlated against experimental results of the Onera wing and the Challenger wing-body configurations. The results are in good agreement with the test data on the Onera M6 wing. The shortcomings with the correct prediction of the shock location on the inboard wing of the Challenger wing-body are thought to be due to the quality of the single block C-type wing-body grid. Further work is required to improve the grid quality, and it is planned to put the boundary layer interaction scheme on a multi-block version of the FLO67 Euler code, currently under development. Author (CISTI)

N92-24860# National Research Council of Canada, Ottawa (Ontario). Inst. for Aerospace Research.
A SCHEME FOR TWO DIMENSIONAL EULER AND BOUNDARY LAYER INTERACTIVE SOLUTIONS
M. Khalid and M. Mokry *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 172-185 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Numerical methods for solving the Euler equations for transonic flows are now almost routinely applied to problems in external and internal aerodynamics. However, Euler equations must be supplied with viscous corrections in situations involving attached flows. The present paper presents a procedure for coupling a boundary layer calculation with a solution of the Euler equations for flow past two dimensional profiles. The interaction of the viscous and inviscid calculations is accomplished by means of an iterative process that involves an adaptation of the mesh for the displacement thickness of the boundary layer and wake shape. The iterative approach used in the work demonstrated an adequately converged solution in 1500 multigrid cycles, utilizing about 170 integral boundary layer and 90 infinite difference boundary layer updates. The turbulence model used in the finite boundary layer subroutine is based on empirical mixing length concepts and renders the code somewhat unsuitable for cases without separation. Robustness and efficiency of the code against demanding aerodynamic cases has not yet been tested.
Author (CISTI)

N92-24861*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A TWO-DIMENSIONAL EULER SOLUTION FOR AN UNBLADED JET ENGINE CONFIGURATION
Mark E. M. Stewart *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 186-193 Previously announced as N92-11328 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

A two dimensional nonaxisymmetric Euler solution in a geometric representation of a jet engine configuration without blades is presented. The domain, including internal and external flow, is covered with a multiblock grid. To construct the grid, a domain decomposition technique is used to subdivide the domain and smooth grids are dimensioned and placed in each block. The grid contains 44 blocks which cover the external field, the inlet, bypass duct, core duct and nozzle of the nonaxisymmetric engine configuration. The geometry is symmetric about the meanline of the hub, but the grid is not since there is no symmetry condition applied to the grid between the two halves. With a symmetric grid at zero angle of attack, the measures of the solution would cancel exactly. With an asymmetric grid, the solution will not necessarily be symmetric and the lift coefficient will not necessarily be zero. Thus, grid asymmetry can be exploited to verify the resolution of the solution. The solution may be verified on the basis of five theoretical quantities: conservation of mass and energy, deviation of the lift coefficient from zero, deviation of the drag coefficient from zero, deviations from constant entropy, and deviations in the pressure distributions over the symmetric surfaces of the components. This technique is suitable for obtaining numerical solutions in complex geometries and provides a foundation for complete engine throughflow calculations. Author (CISTI)

N92-24862# Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
WIND-TUNNEL INVESTIGATION OF AERODYNAMIC AND STABILITY CHARACTERISTICS OF A FORWARD SWEPT WING X-29 MODEL
M. Abramian, P. Kankainen, E. Brundrett, and J. H. G. Howard *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 194-203 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

The X-29 advanced technology demonstrator includes new aerodynamic technologies such as forward swept wing, close-coupled canard, three-surface pitch control configuration, and relaxed (unstable) static margin. The paper describes a preliminary wind tunnel investigation of the static longitudinal characteristics of a 1/24th scale X-29 model which is forced to a stable configuration. Tests were conducted in the recently constructed 2 ft by 3 ft flexible wall wind tunnel at a Reynolds number of 1.85 x 10 to the 5th power based on the mean aerodynamic chord. A comparative study was conducted to investigate the overall aerodynamic performance between a naturally unstable and a forced stable configuration. Each configuration corresponds to various combinations of control surface (strake and canard) deflections and moment reference center locations, the effects of which on the aerodynamic coefficients were analyzed. The variation of the model aerodynamic center with the above configurations was also discussed. A preliminary flow visualization study was

also conducted to qualitatively verify and describe the unsteady flow phenomena associated with the interaction between the canard and the forward swept wing. The identified stable configurations will be used for further flight tests to be conducted of a 1/8th scale radio controlled model. The present investigation is the initial attempt in a series of research projects set out to study the above technologies and their integrated effects on the aerodynamic performance of the X-29 and other forward swept wing aircraft. Author (CISTI)

N92-24863# National Research Council of Canada, Ottawa (Ontario). Applied Aerodynamics Lab.

PROPELLER NOISE RESEARCH AT NRC

N. G. Ball and D. J. Barber (Boeing Canada Ltd., Downsview, Ontario) *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 205-216 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

An acoustic liner has recently been built for the Institute for Aerospace Research 2 m by 3 m Low Wind Speed Tunnel. In conjunction with an improved transverse mechanism and a new high speed data system, the liner allows for measurements of the near-field harmonic noise produced by model scale propellers. Recent tests made in cooperation with Boeing of Canada Ltd., de Havilland Division have shown promising results for measurements of the blade passage tone and its first two harmonics. The measurement technique and data reduction method was able to provide a detailed mapping of both the magnitude and phase of the blade passage tone and its harmonics. The initial data show the importance of maximizing the distance between the microphone and the reflecting surfaces and raises the concern about the importance of the nacelle as a disturbance to the acoustic field. It also shows the importance of the relative phase of the harmonics in assessing the acoustic impact sound field. The facility is capable of making noise measurements that are scaled correctly, with the exception of Reynolds number, up to low speed cruise conditions for modern propeller powered aircraft. This range is adequate to provide data for code validation and limited data for comparison with flight tests. Author (CISTI)

N92-24864# Ottawa Univ. (Ontario). Dept. of Mechanical Engineering.

NONLINER ASPECTS OF TRANSONIC AEROELASTICITY

H. S. Murty and G. W. Johnston (Toronto Univ., Ontario) *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 218-237 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Linear flutter analysis has been traditionally used in studies of transonic flow. A study of the effects of nonlinear transonic flow on the flutter characteristics of an airfoil is reported. The object was to determine the aerodynamic conditions under which the aerodynamic forces are essentially linear functions of airfoil motion and whether the effect of nonlinear aerodynamic forces of flutter are significant enough to invalidate the linear assumptions in traditional flutter analysis. Nonlinear effects were found to be significant for cases in which the amplitude of shock wave motion, over one cycle of unsteady oscillatory motion was greater than 5 percent chord. Assuming linearity of the transonic loads, a linear flutter analysis was carried out to determine neutral stability conditions. A time response analysis of the system at these neutral stability conditions revealed that in cases of strong aerodynamic nonlinearities, the neutral stability condition determined by traditional methods was not correct. Author (CISTI)

N92-24865# National Research Council of Canada, Ottawa (Ontario). High Speed Aerodynamics Lab.

FLOWFIELD IN THE VICINITY OF THE F/A-18 VERTICAL FIN AT HIGH-ANGLE-OF-ATTACK

B. H. K. Lee, D. Brown, F. C. Tang, and M. Plosenski *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 238-250 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

The flowfield behind the vertical fin of a rigid 6 percent scale F/A-18 model was investigated in the Institute for Aerospace Research 1.5 m Trisonic Blowdown Tunnel. The vortical flow structure was studied with the aid of a 49 pressure sensor rake mounted on the model sting. Unsteady pressures were measured from 13 fast response transducers along the horizontal and vertical centrelines of the vortex rake. Spectral, correlation and probability density analyses were carried out. Higher pressure fluctuations in the flowfield were observed on the inboard side of the vertical fin at alpha = 30 deg and 35 deg. At alpha = 25 deg the vortex center was located outboard of the vertical fin. Larger pressure fluctuations were observed on the outboard side of the vertical fin. Above alpha = 30 deg, pressure fluctuations measured with the vortex rake mounted between the vertical fins show quite similar results for M = 0.6 and 0.8. Some representative results from statistical analyses of the unsteady pressures are given at M = 0.6 and alpha = 30 deg. Spectral studies of the vortical flowfield unsteady pressures show regions where a broad peak with a reduced frequency between 0.45 and 0.5 are detected. Cross correlation analyses indicate the pattern of vorticity to be convected mainly in the free-stream direction. The scale of eddies are not constant at different locations in the flowfields. With the vortex rake mounted behind the vertical fin, the probability densities of the unsteady transducers' signals show that the pressure fluctuations in most of the flowfield can be approximated by a Guassian distribution. Author (CISTI)

N92-24866# Carleton Univ., Ottawa (Ontario). Dept. of Mechanical and Aerospace Engineering.

PERFORMANCE DEGRADATION DUE TO HOAR FROST ON LIFTING SURFACES

R. J. Kind and M. A. Lawrysyn *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 253-263 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

This paper outlines an investigation into the effects of hoar frost roughness on the aerodynamic performance of airfoils and wings. The aerodynamic characteristics of actual, naturally grown, hoar frost were determined by testing several preserved samples in a wind tunnel. Boundary layer development over the samples was measured. Effective roughness height and spacing parameters were determined from the data. Computations were then carried out to assess the effects of frost on airfoil performance. These computations were done using a viscous/inviscid interaction approach. The computations indicate that frost in the leading edge region can have dramatic negative effects on airfoil and wing performance. Frost of only 0.4 mm height was predicted to cause take-off distance to increase by more than 80 percent when present in the leading edge region of a large transport aircraft's wing. On the other hand, frost beginning well downstream of the suction peak, for example at one-quarter chord, was predicted to have little effect. Author (CISTI)

N92-24867# National Defence Headquarters, Ottawa (Ontario). Directorate Aerospace Support Engineering.

HELICOPTER STORE SEPARATION: A PREDICTIVE TECHNIQUE

M. Tremblay *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 289-304 (For primary document see N92-24849 15-02)

Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

The development of a helicopter store separation prediction method is described. The development represents a first attempt to obtain a quick method of predicting store separation and to identify potential helicopter store certification problems. The method is based on RAENEAR store separation prediction program, RAE HOVER rotor performance prediction program, and a store

aerodynamics prediction technique. A number of refinements were made to these programs and include modified rotor blade loading and store aerodynamic loading prediction techniques. Trajectory predictions were calculated for two stores, a missile and a rocket launcher, when released from a helicopter in hover and low speed forward flight. It was found that, as expected, for a high mass store the rotor wake has small effects on store trajectory after release. For a low mass store, only the angular displacement in pitch is significantly affected by the rotor wake and its magnitude and direction depends mainly on the helicopter forward speed. Using a limited amount of experimental data, it was shown that the method can be expected to be reasonably accurate for preliminary analysis of helicopter store separation.

Author (CISTI)

N92-24868# Bombardier, Inc., Montreal (Quebec).
STORE SEPARATION MODEL FOR RIPPLE RELEASE
F. A. Kohiyar, M. Tremblay, and C. Gauthier (Directorate Fighter and Trainer, Ottawa, Ontario) *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 305-323 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

This paper describes the salient features of the CF-18 store separation analytical model (SSM). Current store separation models are unable to accurately predict trajectories for ripple releases. The requirement for the ripple release capability was identified during certification flight trials on the CF-18. It was observed that the second released store from a given wing station had a significantly different separation trajectory from the first store. The SSM is a FORTRAN computer program which computes the trajectory of each released store relative to the parent aircraft by a step-by-step calculation of the motion of the aircraft and released stores. One unique feature of the SSM is that it takes into account the wing elasticity to predict the store ejection forces. The SSM was validated using flight test data and yielded realistic results. The SSM is capable of simulating separation trajectories of up to ten unpowered stores, released sequentially at very short time intervals. Author (CISTI)

N92-24869# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
AUTOMATED GRID GENERATION FOR HIGH-LIFT CONFIGURATIONS
T. E. Nelson, D. W. Zingg, and G. W. Johnston *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 324-337 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

An automated procedure is presented for generating multi-block grids around two-dimensional high-lift airfoil configurations. The computational domain is subdivided into simply connected topologically rectangular blocks by tracing streamlines and equipotential lines determined from a panel method. The procedure is suitable for any number of elements with or without gaps and overlaps. Also, sharp corners and blunt trailing edges are easily accommodated. Within each block, a starting grid is generated using a simple algebraic technique. The composite grid is then smoothed using an elliptic grid generation method to produce a final grid suitable for Navier-Stokes computations. Sample grids are presented for a two element case of the GW(W)-1 airfoil with 29 percent airfoil chord Fowler flap at 40 deg and a three element case of the GA(W)-1 airfoil with flap and slat. To demonstrate the usefulness of the method, numerical results for the two element case from an established Navier-Stokes code are presented and compared to wind tunnel data. Author (CISTI)

N92-24870# University of Western Ontario, London.
FLOW VISUALIZATION USING COMPUTER ANIMATION
J. M. Floryan *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 338-341 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Effective numerical simulations of fluid motions hinge on availability of techniques for extracting and displaying physically relevant information that is hidden in the large data sets generated by computer. Graphical postprocessing and computer animation are most effective in the case of unsteady motions. Algorithms based on light propagation in absorbing, emitting and scattering media offer a promise for effective display of three dimensional fields. This presentation focuses on techniques that can be used for flow visualization purposes using computer animation. Different techniques were illustrated using video clips taken from various branches of fluid dynamics. These videos demonstrated the versatility and power of flow animation methodology. Very realistic flow simulations can be carried out. Most of the techniques are quite simple and have analogues in actual physical experiments. Animation of two dimensional fields can effectively be carried out using presently available methodology involving a mixture of Langrangian and Eulerian concepts. Effective displaying of three dimensional fields is cumbersome and requires development of new methods. Algorithms based on ray propagation in an absorbing, emitting and scattering medium give best results. Author (CISTI)

N92-24871# Sherbrooke Univ. (Quebec). Dept. of Mechanical Engineering.
VIBROACOUSTIC SIMULATION OF AN AIRPLANE STRUCTURE
L. Cheng and J. Nicolas *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 343-354 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

An analytical model is presented which is intended to investigate the vibroacoustic behavior of an airplane structure. Important phenomena have been revealed through numerical investigations. The proposed approach offers a new way of addressing mechanically coupled structures. The idea of using dynamic distribution of springs offers a new possibility of handling structural complexities at substructure junctions and boundaries. This method offers an alternative to purely numerical methods such as FEM usually used to address this kind of problem. By the comparisons with FEM, the present method is more physical, convenient, and efficient in terms of computation time. It offers a general formulation encompassing various boundary cases for the plates and shells. It also contributes to the understanding of structural coupling. In addition, numerical study on the effect of the bulkhead fixing furnishes useful sound proofing guidances. Author (CISTI)

N92-24872# Ottawa Univ. (Ontario). Dept. of Mechanical Engineering.
NONUNIQUE SOLUTIONS IN UNSTEADY TRANSONIC FLOW
H. S. Murty *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 355-364 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

The purpose of the present work was to study the occurrence of nonunique solutions in unsteady transonic flows. In this study, a full potential unsteady code was developed and applied to the analysis of flows past NACA 0012 and NACA 64A006 airfoils. Whereas previous studies provided examples of nonunique solutions using the small disturbance potential flow model, the full potential flow model could not verify those solutions. It is not the neglect of shock wave generated vorticity and entropy that is responsible for the nonunique phenomena as all potential flow models share the assumption of isentropic flow. It is possible that the variation in modelling the wake boundary conditions may affect the solution obtained. Author (CISTI)

N92-24873# Defence Research Establishment Suffield, Ralston (Alberta).
BOUNDARY LAYER COMPUTATIONS USING A GENERALIZED FORMULATION **c34**
D. Bergeron and D. W. Zingg *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 365-378 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

A numerical solution procedure for a generalized form of the boundary-layer equations based on the formulation of Steger and Van Dalsem is described. The formulation, which is intended for use in a fortified Navier-Stokes procedure, uses the boundary-layer equations expressed in body-confromal coordinates but transformed into generalized coordinates for the solution process. Results are presented for attached and separated transonic airfoil flows with external pressure gradient given from a Navier-Stokes solution in the boundary layers. Discrepancies are noted near shocks and trailing edges, where normal pressure gradients can be appreciable and streamwise velocity gradients can be high.
Author (CISTI)

N92-24874# Canadian Forces Headquarters, Ottawa (Ontario).
THE EFFECT OF DROPLET SIZING UNCERTAINTY ON ICE ACCRETIONS **c34**
Robert G. Foster and C. Scott Bartlett (Arnold Engineering Development Center, Arnold Air Force Station, TN.) *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 379-391 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Data to evaluate the safe operational limits of aircraft and propulsion systems in icing environments can be obtained during ground testing. A concern in the conduct of these tests is how closely the icing test parameters must be known and how the uncertainties in these parameters affect the icing test results. In this paper, experimental droplet sizing data uncertainties are discussed and relative bias errors as large as 15 microns in mass median diameter measured by different droplet sizing instruments are identified. Experimental and analytical results are presented to illustrate the sources and magnitude of droplet sizing bias errors. Ice accretion test results of a NACA 0012 airfoil at low speed were used to illustrate the impact of these errors. Droplet sizing instrumentation comparison tests have demonstrated large bias errors between instrument measurements. Droplet sizing instrument accuracy is dependent on many factors including the particular test conditions being measured. The impact droplet sizing errors on ice accretion test results is dependent on the particular test conditions. Ice accretion shape predictions made with the LEWICE model show a strong sensitivity to droplet size, thus agreeing with the experimental data trends. The influence of droplet size variations on predicted ice shapes is sometimes different than the influence on the experimentally accreted ice shapes. Parametric studies such as those conducted for ice accretion shape changes caused by droplet size variations offer a means to understand sensitivity of test results to experimental uncertainty and can help guide refinements in mathematical models.
Author (CISTI)

N92-24875# National Research Council of Canada, Ottawa (Ontario). Inst. for Aerospace Research.
INFLUENCE FUNCTION METHOD APPLICATION TO PREDICTION OF STORE AERODYNAMIC LOADS DURING SEPARATION FROM THE CF-18 FIGHTER PLANE
Ahmed Malek *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 392-424 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

A hybrid (numerical - experimental) technique has been developed to reliably predict the aerodynamic loads for a series of external stores, based on the influence function method (IFM). This method recognizes the every store has a unique response to the local flow angularities, both the upwash and sidewash distributions, in the proximity of the parent aircraft; and it utilizes the data of the influences for various segments of the store (store influence coefficients) on the total forces and moments. The store influence coefficients (ICs) are obtained through a calibration procedure in a known non-uniform flow of a calibration body (in this case an Ogive cylinder). The IFM results obtained in this investigation have shown reasonable agreement with the conventional grid measurements of the aerodynamic loads of the CF-18 fighter plane standard external stores, LAU-5003 and MK-82, at a flight Mach number of 0.75. This investigation has also shown that it is possible to use store influence coefficients of one flight Mach number. The results have indicated that using the probe store technique to deduce the parent aircraft flowfield angularities is not very reliable, particularly at high flight Mach number. This leaves the users of IFM with the other technique of directly measuring the parent aircraft flowfield angularities, and the results have shown this technique to be successful.
Author (CISTI)

N92-24876# Alberta Univ., Edmonton. Dept. of Mechanical Engineering.
AERODYNAMIC DESIGN AND ANALYSIS OF A LIGHT AIRCRAFT PROPELLER
B. D. Murray *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 425-438 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Based on the now classical propeller theory, design and analysis routines appropriate for lightly loaded propellers have been developed. The analysis routine is based upon the blade element and momentum theory and is shown to agree well with experimental results. The iterative solution did demonstrate poor convergence near the tips of blunt ended blades but this difficulty was overcome by introducing a control point just off the blade tip. The design method utilizes a helicoidal vortex wake of constant displacement velocity, as the basis for determining the optimum blade shape. The solution of the trailing vortex wake is only approximate, but nevertheless the performance characteristics as designed do agree well with the analytical performance characteristics. These routines are executed very efficiently on personal computers which has facilitated the actual design and analysis of a propeller. An optimum propeller was designed for a light aircraft that was to operate efficiently at speeds of 50 to 200 mph with an 80 HP engine.
Author (CISTI)

N92-24877# Alberta Univ., Edmonton. Dept. of Mechanical Engineering.
VARIABLE GEOMETRY SAILPLANES MINISIGMA
D. J. Marsden *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 439-455 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

Variable geometry on sailplanes refers to the use of some mechanical methods of changing the effective wing area to provide a better compromise between the requirements for circling and cruising flight. Successful application of this concept has proved an elusive goal. Two of the most successful flap systems are the Wortmann flap used on the original Sigma and the SB-11, and the slotted flap used on the Gemini and on the modified Sigma. The slotted flap system has a number of advantages, a major one being that it allows for more effective aileron control at low speeds. The design philosophy of the new Minisigma has been to obtain superior high speed performance through the use of a high wind loading while retaining the best features of the Sigma and Gemini, namely excellent low speed performance and handling. High wing loading can be achieved without excessive weight because of the relatively small area of the aspect ratio 27 wing. The slotted flap provides the best solution for variable geometry. It provides nearly two to one increase in effective wing area while maintaining effective aileron control power at low speeds. It has higher drag than the unslotted Fowler flap but its higher operating

lift coefficient more than compensates for the difference. Safety is not compromised for heavy wing loading. The slotted flap provides impressive gains in safe handling even in the case of full water ballast. Author (CISTI)

N92-24882*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EXPERIMENTAL EVALUATION OF A FLAT WAKE THEORY FOR PREDICTING ROTOR INFLOW-WAKE VELOCITIES
John C. Wilson Apr. 1992 53 p Prepared in cooperation with Army Aviation Systems Command, Hampton, VA
(DA Proj. 1L1-62211-A-47-A)
(NASA-TM-4334; L-16953; NAS 1.15:4334;
AVSCOM-TR-92-B-004) Avail: NTIS HC/MF A04 CSCL 01A

The theory for predicting helicopter inflow-wake velocities called flat wake theory was correlated with several sets of experimental data. The theory was developed by V. E. Baskin of the USSR, and a computer code known as DOWN was developed at Princeton University to implement the theory. The theory treats the wake geometry as rigid without interaction between induced velocities and wake structure. The wake structure is assumed to be a flat sheet of vorticity composed of trailing elements whose strength depends on the azimuthal and radial distributions of circulation on a rotor blade. The code predicts the three orthogonal components of flow velocity in the field surrounding the rotor. The predictions can be utilized in rotor performance and helicopter real-time flight-path simulation. The predictive capability of the coded version of flat wake theory provides vertical inflow patterns similar to experimental patterns. Author

N92-24885*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EFFECT OF BLADE PLANFORM VARIATION ON THE FORWARD-FLIGHT PERFORMANCE OF SMALL-SCALE ROTORS
Kevin W. Noonan, Susan L. Althoff, Dhananjay K. Samak, and Michael D. Green (Maryland Univ., College Park.) Apr. 1992 83 p
(DA Proj. 1L1-62211-A-47-A)
(NASA-TM-4345; L-16994; NAS 1.15:4345;
AVSCOM-TR-92-B-005) Avail: NTIS HC/MF A05 CSCL 01A

An investigation was conducted in the Glenn L. Martin Wind Tunnel to determine the effect of blade planform variation on the forward-flight performance of four small-scale rotors. The rotors were 5.417 ft in diameter and differed only in blade planform geometry. The four planforms were: (1) rectangular; (2) 3:1 linear taper starting at 94 percent radius; (3) 3:1 linear taper starting at 75 percent radius; and (4) 3:1 linear taper starting at 50 percent radius. Each planform had a thrust-weighted solidity of 0.098. The investigation included forward-flight simulation at advance ratios from 0.14 to 0.43 for a range of rotor lift and drag coefficients. Among the four rotors, the rectangular rotor required the highest torque for the entire range of rotor drag coefficients attained at advanced ratios greater than 0.14 for rotor lift coefficients C sub L from 0.004 to 0.007. Among the rotors with tapered blades and for C sub L = 0.004 to 0.007, either the 75 percent tapered rotor or the 50 percent tapered rotor required the least amount of torque for the full range of rotor drag coefficients attained at each advance ratio. The performance of the 94 percent tapered rotor was generally between that of the rectangular rotor and the 75 and 50 percent tapered rotors at each advance ratio for this range of rotor lift coefficients. Author

N92-24898*# MCAT Inst., San Jose, CA.
TURBULENCE MODELING FOR HYPERSONIC FLIGHT
Progress Report
Jorge E. Bardina May 1992 76 p
(Contract NCC2-585)
(NASA-CR-190313; NAS 1.26:190313; MCAT-92-010) Avail: NTIS HC/MF A05 CSCL 01A

The objective of the present work is to develop, verify, and incorporate two equation turbulence models which account for the effect of compressibility at high speeds into a three dimensional Reynolds averaged Navier-Stokes code and to provide documented model descriptions and numerical procedures so that they can be implemented into the National Aerospace Plane (NASP) codes. A summary of accomplishments is listed: (1) Four codes have been tested and evaluated against a flat plate boundary layer flow and an external supersonic flow; (2) a code named RANS was chosen because of its speed, accuracy, and versatility; (3) the code was extended from thin boundary layer to full Navier-Stokes; (4) the K-omega two equation turbulence model has been implemented into the base code; (5) a 24 degree laminar compression corner flow has been simulated and compared to other numerical simulations; and (6) work is in progress in writing the numerical method of the base code including the turbulence model. H.A.

N92-24956*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
OBSERVATIONS ON COMPUTATIONAL METHODOLOGIES FOR USE IN LARGE-SCALE, GRADIENT-BASED, MULTIDISCIPLINARY DESIGN INCORPORATING ADVANCED CFD CODES
P. A. Newman, G. J.-W. Hou, H. E. Jones, A. C. Taylor, III, and V. M. Korivi (Old Dominion Univ., Norfolk, VA.) Feb. 1992 19 p
(NASA-TM-104206; NAS 1.15:104206; AVSCOM-TR-92-B-007)
Avail: NTIS HC/MF A03 CSCL 01A

How a combination of various computational methodologies could reduce the enormous computational costs envisioned in using advanced CFD codes in gradient based optimized multidisciplinary design (MdD) procedures is briefly outlined. Implications of these MdD requirements upon advanced CFD codes are somewhat different than those imposed by a single discipline design. A means for satisfying these MdD requirements for gradient information is presented which appear to permit: (1) some leeway in the CFD solution algorithms which can be used; (2) an extension to 3-D problems; and (3) straightforward use of other computational methodologies. Many of these observations have previously been discussed as possibilities for doing parts of the problem more efficiently; the contribution here is observing how they fit together in a mutually beneficial way. Author

N92-24958*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SUPERSONIC JET MIXING ENHANCEMENT BY DELTA-TABS
K. B. M. Q. Zaman, M. F. Reeder, and M. Samimy (Ohio State Univ., Columbus.) 1992 17 p Proposed for presentation at the 28th Joint Propulsion Conference and Exhibit, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA, SAE, ASME, and ASEE
(NASA-TM-105664; E-6993; NAS 1.15:105664; AIAA-92-3548)
Avail: NTIS HC/MF A03 CSCL 01A

The results of a continuing investigation of the effect of vortex generators, in the form of small tabs at the nozzle exit, on the evolution of a jet are reported. Primarily, tabs of triangular shape are considered, and the effect is studied up to an equivalent jet Mach number of 1.8. By changing the orientation of the tab with respect to the nozzle exit plane, streamwise vortex pairs of opposite sign were generated. This resulted in either an outward election of jet core fluid into the ambient or an inward indentation of the mixing layer into the core of the jet. A triangular shaped tab with its apex leaning downstream, referred to as a delta tab, was found to be the most effective in influencing the jet evolution. Two delta tabs, spaced 180 degrees apart, completely bifurcated the jet. Four delta tabs increased jet mixing substantially, more than by various other methods tried previously; the mass flux at fourteen jet diameters downstream from the nozzle increased by about 50 percent over that for the no tab case. The tabs were found to be effective in jets with laminar or turbulent boundary layers as well as in jets with low or high core turbulence intensities. Author

N92-24977*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LONGITUDINAL AND LATERAL-DIRECTIONAL AERODYNAMIC CHARACTERISTICS OF A WING-CONE CONFIGURATION AT MACH NUMBERS FROM 2.5 TO 4.5
Peter F. Covell, Ira J. Walker (Lockheed Engineering and Sciences

Co., Hampton, VA.), and Dorothy T. Howell May 1992 176 p Contains MF as supplement
(NASA-TM-4337; L-16839; NAS 1.15:4337) Avail: NTIS HC/MF A09 CSCL 01A

A study was conducted to determine the longitudinal and lateral-directional aerodynamic characteristics of a generic wing-cone configuration at supersonic speeds. The fuselage has a 5 deg half-angle cone forebody, cylindrical midbody, and a 9 deg truncated cone afterbody. The delta wing (aspect ratio 1.0) had a 4 pct. thick diamond airfoil section. The tests were made in the Langley Unitary Plan Wind Tunnel at Mach numbers from 2.50 and 4.50. Angle of attack was varied from -4 to 28 degs, and angle of sideslip varied from -8 to 8 degs. Several configurations were studied to determine the effects of variations in wing longitudinal position, wing incidence, vertical tail configuration, canard shape, and nose bluntness. Typical effects of Reynolds number and Mach number on the longitudinal characteristics were observed. The incremental effects of the configuration variables were generally unaffected by Mach number. The directional stability characteristics of the large and small centerline mounted vertical tail configurations were significantly degraded with increasing angle of attack and Mach number.
Author

N92-25133*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMPARISON OF JET PLUME SHAPE PREDICTIONS AND PLUME INFLUENCE ON SONIC BOOM SIGNATURE
Raymond L. Barger and N. Duane Melson Mar. 1992 23 p
(NASA-TP-3172; L-16970; NAS 1.60:3172) Avail: NTIS HC/MF A03 CSCL 01A

An Euler shock-fitting marching code yields good agreement with semiempirically determined plume shapes, although the agreement decreases somewhat with increasing nozzle angle and the attendant increase in the nonisentropic nature of the flow. Some calculations for the low boom configuration with a simple engine indicated that, for flight at altitudes above 60,000 feet, the plume effect is dominant. This negates the advantages of a low boom design. At lower altitudes, plume effects are significant, but of the order that can be incorporated into the low boom design process.
Author

N92-24393# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Geometrie und Praktische.
SIMULATION OF THE FLOW ON A SPACE GLIDER. STAGNATION POINT CALCULATION USING THE 2D NAVIER-STOKES EQUATIONS INCLUDING CHEMICAL EFFECTS [STROEMUNGSSIMULATION AN EINEM RAUMGLEITER. STAUPUNKTBERECHNUNG MITTELS DER 2D-NAVIER-STOKES-GLEICHUNGEN MIT CHEMIE]
S. Mueller *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 109-110 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24394# Technische Hochschule, Aachen (Germany, F.R.). Lehr- und Forschungsgebiet fuer Mechanik.
HYPERSONIC CONFIGURATIONS IN SLOW SPEED FLIGHT [HYPERSONISCHE KONFIGURATIONEN IM LANGSAMFLUG]
C.-A. Mueller *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 111-112 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24395# Technische Hochschule, Aachen (Germany, F.R.). Lehr- und Forschungsgebiet fuer Mechanik.
SUPERSONIC FLOW IN COMPRESSION STAGES AND INLETS [UEBERSCHALLSTROEMUNGEN IN VERDICHTERSTUFEN UND EINLAEUFEN]
I. Grotowsky *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 113-114 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24639# Centre National d'Etudes Spatiales, Toulouse (France).
LARGE HEAVY DUTY BALLOONS IN EUROPE
J. P. Diris *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 287-289 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24640# Raven Industries, Inc., Sioux Falls, SD.
RECENT DEVELOPMENTS IN THE USE OF THIN-FILM POLYETHYLENE BALLOONS FOR METEOROLOGICAL APPLICATIONS
Tim W. Markhardt *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 291-294 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24641# Italian Space Agency, Rome. Milo Stratospheric Balloon Launch Base.
GROUND IMPACT POINT FORECAST FOR STRATOSPHERIC BALLOON FLOATING PAYLOAD
O. Cosentino and J. C. Varlet (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 295-298 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24643# Winzen International, Inc., San Antonio, TX.
NYLON 6 SUPERPRESSURE BALLOONS
J. L. Rand, L. G. Seely, T. L. Lew, and M. S. Smith *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 309-313 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24645# Centre National d'Etudes Spatiales, Toulouse (France). Div. Ballons.
THE CONCEPT OF A LONG DURATION STRATOSPHERIC BALLOON [CONCEPT D'UN BALLON STRATOSPHERIQUE OUVERT DE LONGUE DUREE]
Christian Tockert *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 321-325 In FRENCH (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24646# Centre National d'Etudes Spatiales, Toulouse (France). Div. Ballons.
ALTITUDE EXCURSION CONTROLLED BALLOON FOR LONG DURATION FLIGHT [BALLON A EXCURSION D'ALTITUDE COMMANDEE POUR VOL LONGUE DUREE]
V. Dubourg and P. Malaterre *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 327-331 In FRENCH (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24652# Geneva Observatory (Switzerland).
NEW CONCEPTS AND PERFORMANCES IN AZIMUTH CONTROL OF LARGE BALLOON GONDOLAS
F. P. Wildi *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 357-361 Sponsored by CNES; Swiss Foundation for Scientific Research; and Geneva Univ. (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N92-24713# Lawrence Livermore National Lab., CA.
WORLD COMMERCIAL AIRCRAFT ACCIDENTS: 1ST EDITION, 1946-1991
C. Y. Kimura Feb. 1992 240 p
(Contract W-7405-eng-48)
(DE92-009801; UCRL-ID-110003) Avail: NTIS HC/MF A11

This report is a compilation of all accidents world-wide involving aircraft in commercial service which resulted in the loss of the airframe or one or more fatality, or both. This information has been gathered in order to present a complete inventory of commercial aircraft accidents. Events involving military action, sabotage, terrorist bombings, hijackings, suicides, and industrial ground accidents are included within this list. This report is organized into six chapters. The first chapter is the introduction. The second chapter contains the compilation of accidents involving world commercial jet aircraft from 1952 to 1991. The third chapter presents a compilation of accidents involving world commercial turboprop aircraft from 1952 to 1991. The fourth chapter presents a compilation of accidents involving world commercial pistonprop aircraft with four or more engines from 1946 to 1991. Each accident compilation or database in chapters two, three and four is presented in chronological order. Each accident is presented with information the following categories: date of accident, airline or operator and its flight number (if known), type of flight, type of aircraft and model, aircraft registration number, construction number/ manufacturers serial number, aircraft damage resulting from accident, accident flight phase, accident location, number of fatalities, number of occupants, references used to compile the information, and finally cause, remarks, or description (brief) of the accident. The fifth chapter presents a list of all commercial aircraft accidents for all aircraft types with 100 or more fatalities in order of decreasing number of fatalities. Chapter six presents the commercial aircraft accidents for all aircraft types by flight phase. Future editions of this report will have additional follow-on chapters which will present other studies still in preparation at the time this edition was being prepared. DOE

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N92-24799# PERI, Inc., Princeton, NJ.
CONTROLLER MEMORY ENHANCEMENT: FIELD FACILITY CONCEPTS AND TECHNIQUES Technical Report, Jan. - Nov. 1991
Stan Gromelski, Laurie Davidson, and Earl S. Stein Feb. 1992 78 p
(Contract DTFA03-89-C-00050)
(DOT/FAA/CT-TN92/7) Avail: NTIS HC/MF A05

The results are presented of the 2nd year's effort in a 3 yr. project to study the role of memory in air traffic control activities. The goal was to improve controller performance of tasks where memory is a critical element. The specific goals were to identify memory aids currently in use and to explore the techniques that controllers use to manage memory. In-depth interviews were conducted with 170 controllers and a mail survey of 41 facility managers to obtain data on a range of topics, including: incidence of memory lapses; techniques controllers use to maintain awareness; perceptions of the characteristics of outstanding controllers; reported techniques and memory aids in use; and views on effective training techniques. Memory aids are listed. Recommendations are included for further research on techniques for managing memory, on the environment that promote use of memory aids, on particular memory aids, on successful training approaches, and on the establishment of a central clearing house for dissemination of information about these topics. Author

N92-24888# Federal Aviation Administration, Atlantic City, NJ.
MLS AND DME/P MULTIPATH SIMULATION MODEL USER'S MANUAL. VOLUME 1: OPERATING INSTRUCTIONS Report, Sep. 1991
Feb. 1992 132 p
(NASA Order T-06038)
(DOT/FAA/CT-TN91/47) Avail: NTIS HC/MF A07

The following topics are addressed: descriptions of the model, both general and detailed; discussion of the input parameters and creation of the input file; instructions for operating each program of the model; discussion of the various options available for a given simulation; and description of the output tables, plots, and files produced by each program. A sample input file and a set of the resulting output plots and tables are included. Author

N92-25098# Federal Aviation Administration, Atlantic City, NJ.
NATIONWIDE SYSTEM DELAY STUDY OF THE MICROWAVE LANDING SYSTEM IN THE NEW YORK TERMINAL AREA, VOLUME 1 Technical Report, Jan. - Sep. 1991
Kimberly A. May, Joseph M. Richie, Arthur P. Pomerantz, and Edward J. Wiston, II Dec. 1991 32 p
(DOT/FAA/CT-TN91/59-Vol-1) Avail: NTIS HC/MF A03

This report contains the results of a study simulating key features of the Microwave Landing Systems in the New York Terminal Area. This analysis was conducted using the National Airspace Systems Performance Analysis Capability (NASPAC) simulation model. The results will be used by the MLS Program Office (AND-30) in assessing the economic benefits of MLS in the New York Terminal Area. This report includes a discussion of the Key features modeled, the analysis approach, and the results of the analysis. This is the first of a two volume set. The second volume describes the results of simulating MLS in the Chicago Terminal Area. Author

N92-24302*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.
A DEMONSTRATION OF CENTIMETER-LEVEL MONITORING OF POLAR MOTION WITH THE GLOBAL POSITIONING SYSTEM
U. J. Lindqwister, A. P. Freedman, and G. Blewitt *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 1-9 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 17G

N92-24322*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.
POSITION DETERMINATION OF A LANDER AND ROVER AT MARS WITH EARTH-BASED DIFFERENTIAL TRACKING
R. D. Kahn, W. M. Folkner, C. D. Edwards, and A. Vijayaraghavan *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 279-293 (For primary document see N92-24301

15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 17G

N92-24735# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
CURRENT ACTIVITIES AND FUTURE PLANS FOR GPS APPLICATIONS
John M. Dow *In its* Spacecraft Flight Dynamics Dec. 1991 p 105-111 (For primary document see N92-24719 15-12)
Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation.*

N92-24347# RAND Corp., Santa Monica, CA.
FROM FARNBOROUGH TO KUBINKA: AN AMERICAN MiG-29 EXPERIENCE
Benjamin S. Lambeth 1991 150 p Repr. from Air Force Magazine, Apr. 1990
(RAND-R-4000-RC; ISBN-0-8330-1191-X) Avail: NTIS HC/MF A07

At the September 1988 Farnborough Air Show, the Soviet MiG-29 aircraft was demonstrated in the West for the first time. On December 15, 1989, the author became the first U.S. citizen to fly the MiG-29 and the first Western pilot invited to fly a combat aircraft of any type inside Soviet airspace since the end of World War 2. This report documents that experience in detail. The most extensive part of the report is the author's account of his MiG-29 flight and what that experience revealed about the aircraft's technical features, cockpit layout, and handling characteristics. H.A.

N92-24556# Doellner (O. Leonard), Tucson, AZ.
RADIANT ENERGY POWER SOURCE FOR JET AIRCRAFT
O. Leonard Doellner Feb. 1992 38 p
(Contracts DE-FG01-86CE-15301; DE-FG01-82CE-15144)
(DE92-008726; DOE/CE-15301/T15) Avail: NTIS HC/MF A03

This report begins with a historical overview on the origin and early beginnings of a radiant energy power source for jet aircraft. The report reviews the work done in Phase 1 (Grant DE-FG01-82CE-15144) and then gives a discussion of Phase 2 (Grant DE-FG01-86CE-15301). Included is a reasonably detailed discussion of photovoltaic cells and the research and development needed in this area. The report closes with a historical perspective and summary related to situations historically encountered on projects of this nature. DOE

N92-24964# Technische Univ., Delft (Netherlands).
CAD PRODUCT DATA EXCHANGE: CONVERSIONS FOR CURVES AND SURFACES Ph.D. Thesis
Anne Elisabeth Vries-Baayens 1991 186 p Sponsored by Netherlands Foundation for Technical Research
(ISBN-90-6275-723-9; ETN-92-91300) Copyright Avail: NTIS HC/MF A09

Problems caused by the increasing product data exchanged between computer aided design (CAD) systems are addressed. One of these problems concerns the exchange of geometrical representations of products. This problem can be solved by methods for the conversion of these representations into each other. The reasons to exchange are described as well as the type of product data which are exchanged and the problems which can occur if these data are exchanged. A number of methods to convert the geometrical representations of curves and free formed surfaces are described. The currently used geometrical representations on CAD systems were taken into consideration, namely the B spline, Bezier, and power basis representation. The geometry conversions needed were determined for product data exchange between CAD systems. Except for the conversions between the three representations mentioned, it appeared to be necessary to be able to change the degree or parameter area of the representation and to convert an implicit description into an explicit one. Methods for these conversions were developed and are described. Software programs are available for the conversions. ESA

N92-24966# Technische Univ., Delft (Netherlands).
TOWARDS GLARE: THE DEVELOPMENT OF A FATIGUE INSENSITIVE AND DAMAGE TOLERANT AIRCRAFT MATERIAL Ph.D. Thesis
Gerardus Hubertus Jo Roebroeks 1991 273 p Sponsored by Akzo Zout Chemie
(ETN-92-91301) Avail: NTIS HC/MF A12

The constant amplitude fatigue behavior of ARALL is investigated. The fatigue crack growth rates in ARALL 2 increase considerably when failure of the crack bridging fiber layers occurs. This fiber failure behavior was studied. The influences of fatigue loading conditions and specimen geometry, are shown. The fiber failure model was used to develop a material in which fiber failure does not occur. In this material (GLARE), high strength glass fibers are used instead of aramid fibers. The strength (both notched and unnotched specimen) of ARALL and a first version of GLARE are compared. A clear advantage of GLARE over ARALL is found. The composition of GLARE is optimized. ESA

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N92-24689*# Computer Sciences Corp., Hampton, VA.
ADVANCED TRANSPORT OPERATING SYSTEM (ATOPS) CONTROL DISPLAY UNIT SOFTWARE DESCRIPTION
Christopher J. Slominski, Mark A. Parks, Kelly R. Debure, and William J. Heaphy Jan. 1992 347 p
(Contract NAS1-19038)
(NASA-CR-189606; NAS 1.26:189606) Avail: NTIS HC/MF A15 CSCL 09B

The software created for the Control Display Units (CDUs), used for the Advanced Transport Operating Systems (ATOPS) project, on the Transport Systems Research Vehicle (TSRV) is described. Module descriptions are presented in a standardized format which contains module purpose, calling sequence, a detailed description, and global references. The global reference section includes subroutines, functions, and common variables referenced by a particular module. The CDUs, one for the pilot and one for the copilot, are used for flight management purposes. Operations performed with the CDU affects the aircraft's guidance, navigation, and display software. Author

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N92-24336# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
BOUNDARY LAYERS IN TURBOMACHINES
1991 496 p Lecture series held in Rhode-Saint-Genese, Belgium,

2-6 Sep. 1991
(VKI-LS-1991-06; ISSN-0377-8312; ETN-92-91262) Avail: NTIS HC/MF A21

An overview of the latest progress made in the understanding of turbomachinery flows is presented. Special emphasis is put on the phenomenon of boundary layer transition. Both experimental and numerical aspects of the problem are considered. A basic description of the fundamental aspects of boundary layers and transition as applied to turbomachinery flows is given. The experimental identification of different flow phenomena within boundary layers and the correct design and exploitation of such experiments are reported. The development of boundary layers along concave surfaces is studied. The modeling of the transition zone in a boundary layer is presented. The unsteady aspects of boundary layers and transition are considered. The present status of numerical modeling of turbomachinery boundary layer flows is dealt with. For individual titles, see N92-24337 through N92-24343.

N92-24337# Rensselaer Polytechnic Inst., Troy, NY. Dept. of Mechanical Engineering.
FUNDAMENTAL ASPECTS OF BOUNDARY LAYERS AND TRANSITION IN TURBOMACHINES
Robert E. Mayle *In* VKI, Boundary Layers in Turbomachines 1991 62 p (For primary document see N92-24336 15-07)
Avail: NTIS HC/MF A21

Boundary layer equations for laminar flow, turbulent flow and intermittent flow are presented. The transition modes in gas turbines are considered. The transition theory is reviewed. Transition experiments are described. The periodic unsteady transition phenomenon, and transition in through flow components are reported, with special emphasis on transition phenomena in compressors, in combustors, and low pressure and high pressure turbines. General flow considerations are given. ESA

N92-24338# Motoren- und Turbinen-Union Muenchen G.m.b.H. (Germany, F.R.).
INVESTIGATIONS OF BLADE ROW INTERACTION AND BOUNDARY LAYER TRANSITION PHENOMENA IN A MULTISTAGE AERO ENGINE LOW-PRESSURE TURBINE BY MEASUREMENTS WITH HOT-FILM PROBES AND SURFACE-MOUNTED HOT-FILM GAUGES
Th. Schroeder *In* VKI, Boundary Layers in Turbomachines 1991 50 p (For primary document see N92-24336 15-07)
Avail: NTIS HC/MF A21

Hot film probe measurements were made downstream of every rotor blade row of a five stage low pressure turbine, in order to enhance the understanding of unsteady flow phenomena in multistage low pressure turbines. Hot film gages glued in the vane surfaces were used to locate the separation. New measuring techniques are presented. Unsteady signal traces were recorded, using fast digital data acquisition systems, and special evaluation procedures. Results obtained in hot film probe measurements and in surface hot film gauge measurements. It is shown that evaluation of these measurements is to be made with the aid of the ensemble averaging technique. ESA

N92-24339# National Aeronautical Lab., Bangalore (India). Jawaharlal Nehru Center for Advanced Scientific Research.
THE DYNAMICS OF THE TRANSITION ZONE AND ITS MODELING **c34**
R. Narasimha *In* VKI, Boundary Layers in Turbomachines 1991 100 p (For primary document see N92-24336 15-07)
Avail: NTIS HC/MF A21

It is shown that the key variable in the transition zone is the 'intermittency' gamma, experimentally defined as the fraction of time that the flow is turbulent at any given station. The basic theory is considered. Hypotheses about spot formation are formulated. Anomalous spot propagation and subtransitions are examined. It is shown that prediction of onset is a major unsolved problem in transition dynamics. The rate at which turbulent spots are born determined the intermittency distribution. Models for the transition zone are reviewed. A linear combination model is described in detail. ESA

N92-24340# Cambridge Univ. (England). Whittle Lab.
ASPECTS OF UNSTEADY BLADE-SURFACE BOUNDARY LAYERS AND TRANSITION IN AXIAL TURBOMACHINES
H. P. Hodson *In* VKI, Boundary Layers in Turbomachines 1991 105 p (For primary document see N92-24336 15-07)
Avail: NTIS HC/MF A21

The importance of unsteady flows in turbomachines is examined in the context of blade surface boundary layer development. The effect of rotor stator interactions on the development of blade surface boundary layers is considered. The effects of unsteady flow on the development of blade surface boundary layers are considered in the context of single state flows. The existence of disturbed laminar, transitional and turbulent flow on a flat plate, compressor and turbine blades is demonstrated. A simple model of unsteady transition is described. More complex models based on the concepts of intermittency are examined. It is shown that the problem of predicting the effects of wake induced transition is reduced to one of predicting the start of transition. ESA

N92-24341# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
BOUNDARY LAYERS AND TRANSITION ON CONCAVE SURFACES **c34**
R. I. Crane *In* VKI, Boundary Layers in Turbomachines 1991 47 p (For primary document see N92-24336 15-07)
Avail: NTIS HC/MF A21

Fundamental aspects of the influence of longitudinal concave wall curvature on laminar and turbulent boundary layers are described. The controlling parameters are introduced. The phenomenon of Goertler instability in laminar layers is covered, including evidence for its occurrence in turbomachines, experimental studies and prediction of Goertler vortex amplification, and the effect in boundary layer growth. Transition in concave surfaces is dealt with. Experiments and attempts to devise new correlations are reviewed. The prospects for improved prediction methods are considered. The effects of concave curvature on laminar and turbulent convective heat transfer and on film cooling are described. ESA

N92-24342# Advanced Scientific Computing G.m.b.H., Holzkirchen (Germany, F.R.).
NUMERICAL PREDICTION OF BOUNDARY LAYERS AND TRANSITIONAL FLOWS **c34**
Georg Scheuerer *In* VKI, Boundary Layers in Turbomachines 1991 73 p (For primary document see N92-24336 15-07)
Avail: NTIS HC/MF A21

Mathematical models and numerical prediction methods for two dimensional boundary layer flows in turbomachines are reviewed. Special emphasis is given to the prediction of laminar turbulent transition, transitional flow and relaminarization. The various physical phenomena affecting the development of blade boundary layers are discussed. The various forms of laminar turbulent transition are physically described. A general classification of mathematical models for predicting transitional boundary layer flows is provided. Statistical turbulence models are discussed in detail. A brief survey of numerical solution methods used for boundary layer flows is presented. Examples of transitional and blade boundary layer calculation using a kappa epsilon low Reynolds number turbulence model are given. The state of the art of 'direct numerical simulations' of transitional and turbulent flows is briefly discussed. ESA

N92-24343# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
BOUNDARY LAYER TRANSITION UNDER THE PRESENCE OF DISCRETE FREQUENCIES IN THE FREESTREAM TURBULENCE SPECTRUM **c34**
Jorge Costa and Tony Arts *In its* Boundary Layers in Turbomachines 1991 46 p (For primary document see

N92-24336 15-07)
Avail: NTIS HC/MF A21

Forced transition flow in a low speed wind tunnel along a flat test surface was studied. The receptivity of the boundary layer flow to the acoustic excitation frequency was evidenced both by the frequency dependent transition Reynolds number and the streamwise intermittency factor distribution. The intermittency measurements were performed using a conditional sampling technique, which includes a new approach to the positioning of the laminar/turbulent status decision threshold. A model providing an estimation, within the transition region, of the turbulence level profiles and the skin friction coefficient is proposed. The growth of selected oscillation modes are compared in a natural and a forced transition situation. ESA

N92-24539*# Wisconsin Univ., Madison.
THREE-DIMENSIONAL MODELING OF DIESEL ENGINE INTAKE FLOW, COMBUSTION AND EMISSIONS
R. D. Reitz and C. J. Rutland Mar. 1992 70 p
(Contract NAG3-1087; DE-AI01-91CE-50306)
(NASA-CR-189126; DOE/NASA/1087-1; NAS 1.26:189126)
Avail: NTIS HC/MF A04 CSCL 21E

A three-dimensional computer code (KIVA) is being modified to include state-of-the-art submodels for diesel engine flow and combustion: spray atomization, drop breakup/coalescence, multi-component fuel vaporization, spray/wall interaction, ignition and combustion, wall heat transfer, unburned HC and NOx formation, soot and radiation, and the intake flow process. Improved and/or new submodels which were completed are: wall heat transfer with unsteadiness and compressibility, laminar-turbulent characteristic time combustion with unburned HC and Zeldo'vich NOx, and spray/wall impingement with rebounding and sliding drops. Results to date show that adding the effects of unsteadiness and compressibility improves the accuracy of heat transfer predictions; spray drop rebound can occur from walls at low impingement velocities (e.g., in cold-starting); larger spray drops are formed at the nozzle due to the influence of vaporization on the atomization process; a laminar-and-turbulent characteristic time combustion model has the flexibility to match measured engine combustion data over a wide range of operating conditions; and finally, the characteristic time combustion model can also be extended to allow predictions of ignition. The accuracy of the predictions is being assessed by comparisons with available measurements. Additional supporting experiments are also described briefly. To date, comparisons with measured engine cylinder pressure and heat flux data were made for homogeneous charge, spark-ignited and compression-ignited engines. The model results are in good agreement with the experiments. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

No abstracts in this category.

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N92-25090*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MECHANICAL DESIGN OF A ROTARY BALANCE SYSTEM FOR NASA. LANGLEY RESEARCH CENTER'S VERTICAL SPIN TUNNEL
J. W. Allred and V. J. Fleck *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 349-366 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 14B

N92-25091*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE 12-FOOT PRESSURE WIND TUNNEL RESTORATION PROJECT MODEL SUPPORT SYSTEMS
Glen E. Sasaki *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 367-381 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 14B

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N92-24585# Pacific Northwest Lab., Richland, WA.
AN INTEGRATED MISSION PLANNING APPROACH FOR THE SPACE EXPLORATION INITIATIVE
E. P. Coomes, J. E. Dagle, J. A. Bamberger, and K. E. Noffsinger Jan. 1992 7 p Presented at the 9th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 13-16 Jan. 1992
(Contract DE-AC06-76RL-01830)
(DE92-008124; PNL-SA-20148; CONF-920104-32) Avail: NTIS HC/MF A02

A fully integrated energy-based approach to mission planning is needed if the Space Exploration Initiative (SEI) is to succeed. Such an approach would reduce the number of new systems and technologies requiring development. The resultant horizontal commonality of systems and hardware would reduce the direct economic impact of SEI and provide an economic benefit by greatly enhancing our international technical competitiveness through technology spin-offs and through the resulting early return on investment. Integrated planning and close interagency cooperation must occur if the SEI is to achieve its goal of expanding the human presence into the solar system and be an affordable endeavor. An energy-based mission planning approach gives each mission planner the needed power, yet preserves the individuality of mission requirements and objectives while reducing the concessions mission planners must make. This approach may even expand the mission options available and enhance mission activities. DOE

N92-24589# European Space Agency, Paris (France).
TENTH ESA SYMPOSIUM ON EUROPEAN ROCKET AND BALLOON PROGRAMMES AND RELATED RESEARCH
Brigitte Kaldeich, ed. Nov. 1991 416 p In ENGLISH and FRENCH Symposium held in Mandelieu-Cannes, France, 27-31 May 1991
(ESA-SP-317; ISBN-92-9092-110-2; ETN-92-91210) Copyright
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Papers are presented in the following areas: national reports; ionosphere/magnetosphere; mesosphere; microgravity: stratosphere; new instrumentation and facilities; balloon technology;

Mars and planets; long duration balloons; and astrophysics and astronomy. Additionally, the Dynamics Adapted Network for the Atmosphere (DYANA) is discussed. For individual titles, see N92-24590 through N92-24664.

N92-24590# Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn (Germany, F.R.). Space Science Div.
THE GERMAN SCIENTIFIC BALLOON AND SOUNDING ROCKET PROGRAMME
A. F. Dahl and M. Otterbein *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 7-14 (For primary document see N92-24589 15-12)
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The scientific balloon and sounding rocket projects form a very successful part of the German space research program. Information on sounding rocket projects in the scientific fields of astronomy, aeronomy, magnetospheric research, and microgravity research is provided. The scientific balloon projects are performed with emphasis on astronomical and aeronomical research. Previous projects undertaken after the last symposium, as well as separations and plans for the future until 1995, are identified.
ESA

N92-24591# Bern Univ. (Switzerland). Inst. fuer Physik.
SWISS SCIENTIFIC BALLOON AND SOUNDING ROCKET EXPERIMENTS 1989-1991
E. Kopp *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 15-17 (For primary document see N92-24589 15-12)
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In cooperation with foreign institutes, several Swiss laboratories participate yearly in large and small balloon flights, and one or two rocket launchings. The fields covered are chemistry and composition of the middle atmosphere, astrophysics (Sun, stars, and interstellar matter), remote sensing of the Earth, and life science.
ESA

N92-24592# Swedish Space Corp., Solna.
THE SWEDISH SOUNDING ROCKET AND BALLOON PROGRAMME
Kaj Lundahl *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 19-22 (For primary document see N92-24589 15-12)
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The Swedish sounding rocket and balloon program is discussed. The investigations relate to geophysical disciplines, astrophysics, and microgravity research. Future scientific projects using sounding rockets and balloons are planned for infrared observations of interstellar medium and investigation on the structure and dynamics of the middle atmosphere above the northern polar region during Summer. Continued studies of auroral electrodynamics have been proposed. These studies will require increased technical capabilities with respect to payload design, rocket performance and ground support as compared with the current program. Of special interest is the joint German Swedish MAXUS program for the launching of sounding rockets up to 900 km altitude giving 15 minutes of microgravity.
ESA

N92-24593# Centre National d'Etudes Spatiales, Paris (France). Direction de la Recherche.
THE FRENCH BALLOON PROGRAMME
I. Sadourny *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 23-26 (For primary document see N92-24589 15-12)
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The French balloon program is almost 30 years old. The launch sites and the different types of balloons are presented. Balloon campaigns carried out during the period 1990/1991 are discussed and campaigns in preparation presented.
ESA

N92-24594# Norwegian Space Center, Oslo.
THE NORWEGIAN SOUNDING ROCKET AND BALLOON PROGRAMME
Arne Gundersen and Bo N. Andersen *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 27-34 (For primary document see N92-24589 15-12)
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The status and development of the Norwegian sounding rocket and balloon program is presented with emphasis on the national scientific activities. The majority of the activities consist of launches from the Andoya rocket range. The launches are intended to investigate processes in the middle and upper atmosphere. The in situ measurements are supplemented by a large number of ground based support instruments. The ongoing and planned projects are described in some detail and the highlights of the latest completed projects are given. The overall program for the period 1991 to 1994 is reviewed.
ESA

N92-24595# Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).
WAVE-PARTICLE INTERACTIONS IN THE HIGH-LATITUDE MAGNETOSPHERE **c46**
R. Pottelette, N. Dubouloz, and R. Treumann (Max-Planck-Inst. fuer Physik und Astrophysik, Garching, Germany, F.R.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 37-40 (For primary document see N92-24589 15-12)
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The high time-resolution of the wave experiments, on board the Viking satellite, has revealed the extreme time variability of the wave phenomena taking place in the key regions of the high latitude magnetosphere, such as dayside cleft and cusp, and nightside auroral oval. The Viking measurements clearly show the importance of localized low frequency (approximately 1 Hz) electric fluctuations for energization of both ions and electrons in the dayside and nightside auroral magnetosphere. The amplitude of the perpendicular component of these fields can reach several hundred mV/m. In close correlation with the low frequency fields, and on the same time scale (approximately 1 s), intense and sporadic Broadband Electrostatic Noise (BEN) emissions are recorded. The electric field amplitude of the BEN emissions reach a few hundred mV/m around the lower hybrid frequency, in the 1 kHz range. In addition, sporadic auroral kilometric radiation bursts are associated with these structures in the nightside auroral oval.
ESA

N92-24596# Swedish Inst. of Space Physics, Kiruna.
THE HOT PLASMA SPECTROMETERS ON FREJA **c19**
O. Norberg and L. Eliasson *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 41-44 (For primary document see N92-24589 15-12)
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The hot plasma instrumentation F3H on the Swedish-German Freja satellite due for launch in 1992 will consist of electron and ion spectrometers. The spectrometer Magnetic imaging Two dimensional Electron (MATE) will measure the two dimensional electron distribution in the spin plane in the energy range 0.1 to 120 keV. The ion mass spectrometer Three dimensional Ion Composition Spectrometer (TICS) measures a full three dimensional distribution in the energy range 0.5 to 15000 eV/q with high mass resolution. The instruments use a particle 'imaging' detector technique based on a large diameter microchannel plate with position sensitive anode. The topics to be studied with the Freja hot plasma spectrometers include auroral particle acceleration, heating and acceleration of ionospheric ions, and the dynamics of

auroral arc systems. Of special importance to the scientific objectives is the high data rate from the Freja instrumentation, the MATE and TICS spectrometers will be sampled every 10 ms, corresponding to a spatial resolution better than 70 m at ionospheric heights. The design, simulation, and calibration of the spectrometers are discussed. ESA

N92-24597# Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
MAGNETIC DISTURBANCES MEASURED ON-BOARD BALLOON IN AURORAL ZONES: PRINCIPLES AND METHODS **c46**
J. P. Ducarteron, J. P. Treilhou, J. Coutelier, J. L. Medale, J. Crasnier, and F. Olivie *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 45-47 Prepared in cooperation with Centre National de la Recherche Scientifique, Toulouse, France and Toulouse Univ., France (For primary document see N92-24589 15-12)
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From a physical model, the mechanical oscillation frequencies of a balloon-gondola load line were computed. It was concluded that sensitive three axis onboard balloon magnetometers should reveal these mechanical oscillations. The method used to estimate the expected resonance frequencies and the remaining geophysical disturbance due to the auroral electrojet is explained. ESA

N92-24598# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (Germany, F.R.).
EUROPEAN RIOMETER OBSERVATION SYSTEM **c46**
E. Nielsen, C. H. Barrow, J. K. Hargreaves, A. Ranta, H. Ranta, P. Stauning, and A. N. Zaitzev (Academy of Sciences, USSR, Moscow) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 49-53 (For primary document see N92-24589 15-12)
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It is proposed to build a ground based system for imaging the spatial distribution and temporal variation of charged particle fluxes precipitating into the high latitude ionosphere. The system will employ the riometer technique, using a new concept in the receivers and a large antenna array phased to receive from 256 narrow beams centered on the zenith. Each beam is approximately 7 degrees wide at half power points. This will give large spatial coverage (300 by 300 km) with high spatial resolution (of the order of 20 by 20 km). The system is computer controlled and so there is no need for the long term stability necessary in traditional riometers; the receivers can be calibrated as often as needed (for example, once a minute) and the output corrected accordingly. Thus it will be possible to achieve a temporal resolution of one second or better in each of the 256 lobes. It is planned to operate the system continuously for at least three years, in Northern Scandinavia. ESA

N92-24599# Norwegian Defence Research Establishment, Kjeller.
THE 20 YEARS WITH ELECTRON BEAM EXPERIMENTS ON ROCKETS AND SATELLITES **c46**
Bernt N. Maehlum *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 55-61 (For primary document see N92-24589 15-12)
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Rocket and satellite borne electron accelerators are utilized for conducting 'controlled' simulation studies of the processes in the upper atmosphere and in the magnetosphere. Investigations of the 'natural' processes in space are conducted by this method as well as basic studies of the interaction between beams of fast electrons and the plasma environment. Highlights from these studies and some of the experimental difficulties are discussed. ESA

N92-24600# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
ACTIVE IONOSPHERIC EXPERIMENTS ON ALFVEN'S CIV EFFECT **c46**
Nils Brenning *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 63-67 Sponsored by Swedish Natural Science Research Council (For primary document see N92-24589 15-12)
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Critical Ionization Velocity (CIV) is addressed. Laboratory experiments in the ionosphere, in the form of shaped charge releases, are discussed. With the lower density and the weaker magnetic field, new types of measurements are possible in the ionosphere. For example, the lower hybrid instability was for a long time assumed, mainly on theoretical grounds, to be a central mechanism in the CIV laboratory experiments. In the ionospheric releases Star of Lima, CRIT1, and CRIT2, these lower hybrid oscillations could indeed be resolved by probe measurements, but it also became clear that they developed into something else during the most intense phase of the interaction. There is the interplay between the 'CIV region' and a much larger surrounding plasma, a problem which cannot be adequately studied in the laboratory. The ionospheric releases shed new light on this problem. ESA

N92-24601# Kiel Univ. (Germany, F.R.). Inst. fuer Experimentalphysik.
RESONANCE CONE DIAGNOSTICS OF IONOSPHERIC PLASMA: A REFINED ANALYSIS OF COREX DATA **c75**
A. Piel, V. Rohde, H. Thiemann, and K. I. Oyama (Tokyo Univ., Sagamihara, Japan) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 69-74 (For primary document see N92-24589 15-12)
(Contract BMFT-PA4-1OM90010)
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A refined analysis of COREX data which invokes the signal attenuation is presented. The COREX resonance cone instrument was part of a coordinated rocket payload for investigating the E region temperature anomaly in the mid-latitude ionosphere. The conventional method of deriving electron density and temperature from the resonance cone's main maximum and interference spacing had given satisfactory agreement of COREX data with independent instruments at E region altitudes. However, in the F layer, a large overshoot in electron density was observed which represents the well known density limit of this method. It is shown that this density limit can be circumvented by analyzing resonance cone amplitudes, and that close agreement is established in the F layer. Moreover, amplitude asymmetries are found to be consistent with electron drift related angular shifts, which hint at an anomalously high electron circulation in the rocket's environment. The influence of collisional damping in the lower E layer is discussed in terms of amplitude ratios. ESA

N92-24602# Bergen Univ. (Norway).
COMPARISON OF AURORAL EMISSION AND EISCAT-DERIVED PLASMA PARAMETERS DURING THE FLIGHT OF NEED-2 **c75**
Finn Soeraas, Kjell Aarsnes, Chris Hall, Asgeir Brekke, Mike Rietveld, and Unni Pia Loevhaug (EISCAT Scientific Association, Ramfjordbotn, Norway) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 75-81 (For primary document see N92-24589 15-12)
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During the flight of the NEED 2 rocket from Andoya Rocket Range (ARR) in 1990, the European Incoherent Scatter (EISCAT) radar monitored the state of the ionosphere at apogee. Simultaneously, all sky television registered time development of auroral forms and hence the intensity of emissions along the magnetic field line passing through the EISCAT scattering volume.

Here, the intensities of the emissions are compared with the plasma parameters determined by EISCAT. A clear correlation between the F region electron temperature and the upper E region optical emission intensity was observed. This is of special interest since the rocket investigated non-Maxwellian electron energy distributions indicated by a combination of high E region electron densities with high F region electron temperatures. ESA

N92-24603*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
NLC-91 **c46**
E. Kopp, G. Witt (Stockholm Univ., Sweden), and R. A. Goldberg *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 85-92 (For primary document see N92-24589 15-12)
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Noctilucent Clouds (NLC)-91 is a multinational rocket and radar program which will take place in Jul. - Aug. 1991 in northern Scandinavia and the Barents Sea. The main objective of the campaign is to determine with in situ experiments the dynamical, electrodynamical, physical, and chemical parameters of an NLC layer combined with ground based visible radar, lidar, and microwave experiments. The altitude resolution of ground based and in situ measurements in the cold mesopause region should be improved in NLC-91 compared to the previous campaigns below 100 m. ESA

N92-24604# Norwegian Defence Research Establishment, Kjeller.
ROCKET FOR OPTICAL STUDIES OF THE NEUTRAL ATMOSPHERE BY LASER DETECTION (RONALD) **c46**
U.-P. Hoppe, E. V. Thrane, T. A. Blix, and T. Eriksen *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 93-98 (For primary document see N92-24589 15-12)
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The development of a new rocket payload for middle atmosphere studies is proposed. The payload will contain two new instruments, a Rayleigh scatter lidar for measurements of density, waves, and turbulence, and a laser spectrometer for measurements of the important minor constituents H2O and CO2. The two instruments are complementary and will provide information on the middle atmosphere photochemistry and its relation to dynamical processes. The new payload includes a sea recovery system and is constructed for multiple launches. ESA

N92-24605# Bonn Univ. (Germany, F.R.). Inst. fuer Physik.
MASERATI: A NEW ROCKETBORNE TUNABLE DIODE LASER EXPERIMENT TO MEASURE TRACE GASES IN THE MIDDLE ATMOSPHERE **c46**
F.-J. Luebken *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 99-104 (For primary document see N92-24589 15-12)
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MASERATI (Middle Atmosphere Spectrometric Experiment on Rockets for Analysis of Trace gas Influences) is a new rocket-borne instrument to measure altitude profiles of trace gases in the mesosphere. It is based on a laser absorption spectrometer where the light source is a solid state Tunable Diode Laser (TDL) operating in the infrared wavelength regime. Two independent TDL's will be used to simultaneously measure carbon dioxide and water vapor. The absorption cell (White cell configuration) is designed such that the laser beams traverse outside the shockfront of the rocket during most of the flight. Altitude profiles of expected signal strength versus instrument sensitivity are discussed. Results of theoretical studies show that non Local Thermodynamic Equilibrium (LTE) effects can be neglected, provided that a fundamental line is chosen. It was found that the shape of the 2 f signal obtained in derivation spectroscopy is not a suitable quantity to measure the Doppler linewidth and can therefore not be used to measure atmospheric temperatures. ESA

N92-24606# EISCAT Scientific Association, Kiruna (Sweden).
APPLICATION OF THE EISCAT RADARS TO MIDDLE ATMOSPHERE RESEARCH **c46**
P. N. Collis *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 105-109 (For primary document see N92-24589 15-12)
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The Earth's middle atmosphere can be probed with the European Incoherent Scatter (EISCAT) radars. For ionospheric heights, this method allows routine determination of neutral density, temperature and winds. In addition, very intense backscattered power is often detected near the Summer mesopause, particularly with the 224 MHz radar. Under such circumstances EISCAT effectively operates as an MST (Mesosphere, Stratosphere and Troposphere) radar. These coherent type echoes act as tracers of the small scale dynamics of the region and provide information on scattering processes. The application of the two methods in EISCAT studies of the middle atmosphere is reviewed in terms of principles, techniques and experimental schemes. Selected results are illustrated. ESA

N92-24607# Bonn Univ. (Germany, F.R.). Inst. fuer Physik.
IRON ATOM DENSITIES IN THE POLAR MESOSPHERE **c46**
M. Alpers and U. vonZahn *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 111-114 (For primary document see N92-24589 15-12)
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First time iron atom density measurements at polar latitudes (69 deg north) by ground based Fe resonance lidar from 24 Mar. - 6 Apr. and 4 Sep. - 9 Oct. 1990 are reported. A regular Fe layer was observed to extend between approximately 80 to 100 km with peak density near 84.5 km and 87 km in spring and autumn, respectively. The peak densities of the regular Fe layer were near 7,000 /cu cm and 11,500 /cu cm in Spring and Autumn respectively. The column densities varied in the range of (1.0 +/- 0.4) times 10(exp 10)/sq cm. In addition, sporadic Fe layers were observed frequently between 86 and 108 km with a maximum peak number density of 83,000/cu cm. ESA

N92-24608# Tromsoe Univ. (Norway). Inst. of Mathematical and Physical Sciences.
CHAOS AS AN ALTERNATIVE ANALYSIS TOOL FOR SOUNDING ROCKET TURBULENCE DATA: AN INTRODUCTION **c77**
C. Hall *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 115-120 (For primary document see N92-24589 15-12)
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An introduction to the practical application of chaos theory to real data is given. Many physicists are interested in using this tool to investigate their data but are not prepared to invest time in obtaining a thorough understanding of the tool itself. While the physicist should be aware of shortcomings and pitfalls, it is not necessary to understand the algorithms in such great detail. The terminology is reviewed and ways in which these concepts may help the physicist solve real problems are discussed. The necessary steps in identification of fractality in real data are outlined and illustrated. ESA

N92-24609# Tromsoe Univ. (Norway). Inst. of Mathematical and Physical Sciences.
ATTRACTOR DIMENSIONALITY FOR MESOSPHERIC TURBULENCE **c46**
C. Hall, E. V. Thrane, and T. A. Blix (Norwegian Defence Research Establishment, Kjeller.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related

Research Nov. 1991 p 121-125 (For primary document see N92-24589 15-12)
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During the early part of 1990, a series of payloads were flown through the Arctic mesosphere and lower ionosphere with the object of determining turbulence parameters. Traditionally, the resulting data are analyzed to yield power spectra of density fluctuations, from which parameters such as eddy diffusion coefficient and energy dissipation rates may be derived. Here, it is shown how the dynamics which give rise to the data are often characterized by fractality, at least in the trajectories in the phase portraits. Furthermore, there is some evidence for strange attractors, thus suggesting the presence of deterministic chaos. Different height regimes exhibit different signatures, suggestive of differing dynamic processes. ESA

N92-24610# Stockholm Univ. (Sweden). Dept. of Meteorology.
THE EXCITATION OF THE CHAMBERLAIN AND HERZBERG 2 BANDS IN THE TERRESTRIAL NIGHTGLOW **c46**
D. P. Murtagh, J. Stegman, and G. Witt *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 127-130 (For primary document see N92-24589 15-12)
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A previous nightglow model was augmented to include the Chamberlain and Herzberg 2 emissions. The Chamberlain data derive from two rocket measurements of the volume emission profile of the 5 to 2 band combined with ground based spectroscopic measurements of the nightglow in the near UV. The Herzberg 2 data come solely from the ground based measurements. The excitation mechanism that is consistent with the data involves only direct excitation through the three body association of oxygen atoms. This is in contrast to the atmospheric band and OI green line emissions. Empirical parameters for the quenching of the two upper states were derived under the assumption that only O and O2 are responsible. ESA

N92-24611# Canadian Space Agency, Ottawa (Ontario).
PROJECT GEMINI: GENERAL EXCITATION MECHANISMS IN NIGHTGLOW **c46**
J. G. Rumbold and F. R. Harris (Herzberg Inst. of Astrophysics, Ottawa, Ontario) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 131-136 (For primary document see N92-24589 15-12)
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In Oct. 1992 three limb imaging spectrographs for airglow will be launched on a sounding rocket from White Sands Missile Range (WSMR), New Mexico, with the objective of studying the chemistry of the lower night time thermosphere. The imagers operate in the visible and are required to have height resolutions of better than 1 km and spectral resolutions between 0.3 nm at 255 nm and 1 nm at 780 nm. The imager designs and the theoretical specifications are presented along with a discussion of the critical payload subsystems. The development of a low cost inertial attitude control system to meet the 0.5 deg pointing accuracy and 0.015 deg/s maximum drift rate required by the imagers is discussed. In addition, potential future uses of the imagers as tools for space science are given. ESA

N92-24612# European Space Agency, Paris (France).
THE IMPORTANCE OF SHORT DURATION (E.G. SOUNDING ROCKET) EXPERIMENTS WITHIN THE CONTEXT OF THE ESA MICROGRAVITY RESEARCH PROGRAMME **c29**
Paul Clancy *In its* 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 139-142 (For primary document see N92-24589 15-12)
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Microgravity research covers experimental work in the areas of materials science, fluid sciences, basic biology and human physiology in orbital or freefall low gravity conditions. The experimental opportunities offered by space platforms cover flight durations ranging from 2 to 3 seconds (drop tubes/towers) to many months (free flying platforms). This information is tabulated. Other features of these platforms such as microgravity levels, typical timescales for experiment execution are also given. Clearly, the different experimental duration capabilities of the various platforms suits them for application to different research subdisciplines. The role of sounding rocket activities in microgravity research is reviewed with special attention to their place within the broader context of an integrated microgravity research program. ESA

N92-24613# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.).
A NOVEL TV TRANSMISSION SYSTEM FOR LONG RANGE MICRO GRAVITY PAYLOADS **c29**
P. Turner *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 143-145 (For primary document see N92-24589 15-12)
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For online TV (television) transmission of experiment images from inside of microgravity payloads, omnidirectional radiating antennas were used in the past. On several locations on the sphere, absolute antenna gains are below -10 dBi. The resulting signal to noise ratio of the demodulated TV image is in the order of 38 dB and less. Future long duration microgravity missions require TV images with a signal to noise ratio of at least 40 dB, especially in light of an increasing number of telescience experiments. To obtain 15 minutes of experiment time, apogees of 900 km are necessary. The additional free space attenuation has to be compensated for either by a larger ground receiving antenna or by a selective radiation on board. ESA

N92-24614# Kayser Threde G.m.b.H., Munich (Germany, F.R.).
DESIGN OF A SERVICE MODULE FOR MAXUS **c19**
W. Engler and G. Schmitt *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 147-150 (For primary document see N92-24589 15-12)
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Almost 30 sounding rocket payloads have been launched to date within the successful TEXUS project, aiming for six minutes of microgravity time. Driven by the strong interest to increase this time span, the MAXUS project was born. MAXUS is a long duration sounding rocket program based upon the experience of TEXUS. However, it incorporates new technical concepts and more sophisticated resources for the experiments. The MAXUS Service Module (MSM) is part of this concept. It is an autonomous instrumentation which gathers pulse code modulation data of all experiments, distributes telecommands and provides two television links. It is equipped with a new designed attitude control system to make best use of an intelligent antenna switching concept on board the payload. ESA

N92-24615# Kayser Threde G.m.b.H., Munich (Germany, F.R.).
RF-SYSTEM DESIGN FOR MAXUS HIGH ALTITUDE SOUNDING ROCKET PAYLOADS **c19**
H. Pfeuffer and W. Engler *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 151-154 (For primary document see N92-24589 15-12)
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The MAXUS Service Module (MSM) incorporates a RF system for television (TV) and telemetry downlink and a telecommand uplink. New high temperature blade type antennas are used to withstand the reentry temperatures and forces. An antenna switching concept is established to optimize the onboard antenna gain for the TV signals. This telecommand receiving system uses

onboard diversity for a safe and reliable RF link. Telemetry data are transmitted via a circular polarized antenna system consisting of four single blade antennas. ESA

N92-24616# Kayser Threde G.m.b.H., Munich (Germany, F.R.).
THE MAXUS PAYLOAD ATTITUDE AND RATE CONTROL SYSTEM UTILIZING FIBRE-OPTIC GYROS **c19**
G. Schmitt, A. Lissner, and B. Eissfeller *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 155-159 (For primary document see N92-24589 15-12)
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MAXUS is the biggest European sounding rocket for microgravity research. The Attitude and Rate Control System (ARCS), as part of the MAXUS Service Module (MSM), controls payload body rates after motor/payload separation and keeps the payload attitude within a predetermined cone throughout the scientific mission. This ensures pointing of the high gain portions of the television, telemetry and telecommand antenna patterns towards the ground stations, enabling adequate RF links. By utilizing the ARCS with three fiber optic gyros and a 68020 CPU based microcomputer for the attitude and heading reference system, a new technology was successfully implemented. The computer performs a highspeed quaternion update algorithm, scaling and compensation of gyro signals, coning correction and Euler angle extraction. Control torques are executed by a two level cold gas thruster system. ESA

N92-24617# OHB-System G.m.b.H., Bremen (Germany, F.R.).
BALLOON-BORNE DROP CAPSULE MIKROBA **c29**
K. Kretzschmar, A. Kellig, and W. R. Kuebler (Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn, Germany, F.R.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 161-167 (For primary document see N92-24589 15-12)
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The Mikroba (German acronym for microgravity with balloon) drop capsule is addressed. A stratospheric balloon about 615,000 cu cm will carry up a drop capsule with the capacity of up to 200 kg experimental payload to altitudes between 40 ad 45 km. Reaching the operational altitude, the capsule will be released via telecommand. The g level 'switches' from 1 g to nearly zero g; microgravity conditions are realized inside the Mikroba capsule during the phase of free fall. A regulated cold gas thrust system compensates for the increasing aerodynamic drag to achieve up top 60 seconds micro g conditions in the region of 0.001 g. Parachute activation at an altitude between 20 and 14 km terminates the period of microgravity and guarantees a soft landing. ESA

N92-24618# Italian Space Agency, Rome.
GIZERO: A SYSTEM TO PERFORM SCIENTIFIC EXPERIMENTATION UNDER MICROGRAVITY CONDITIONS USING STRATOSPHERIC BALLOONS **c29**
G. Rum, F. Fuligni, and V. Iafolla (Consiglio Nazionale delle Ricerche, Frascati, Italy) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 169-171 (For primary document see N92-24589 15-12)
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The need to test on ground high sensitive scientific instruments in an environment free from gravity and from dynamic perturbation has lead to the preliminary definition of a system, GIZERO, capable of offering a residual gravity level better than 10E-8 g and dynamic perturbations of the order of 10E-12 g/Hz. The basic idea is to realize the freefall conditions on a test platform under vacuum, also eliminating the effect of the air drag. This is obtained by the release of a capsule, lifted up to 40 km by means of a stratospheric balloon that houses the test platform, that, in turn, is released and starts its relative motion to the capsule. The test platform is under vaccuum and practically in an inertial reference system for the time of the relative motion between the ceiling and the bottom of the capsule, for about 25 seconds. Details of the general concept, the system configuration and initial test results are given. The development program is outlined. ESA

N92-24619# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
IN-SITU BALLOON MEASUREMENT OF LOCAL STRATOSPHERIC DYNAMICS CHARACTERISTICS **c46**
J. Barat and C. Cot *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 175-178 (For primary document see N92-24589 15-12)
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A method using highly sensitive balloon borne instrumentation which allows study from in situ measurements of the vertical structure and energy flux of the stratospheric flow from the turbulent scale to the mesoscale is presented. Two experimental techniques are detailed. Major results are presented, and the method is discussed for the case of a long time flight balloon experiment. ESA

N92-24620# Centre National de la Recherche Scientifique, Paris (France). Lab. de Physique Moleculaire et Applications.
BALLOON-BORNE SOLAR OCCULTATION FOURIER TRANSFORM SPECTROMETRY FOR MEASUREMENTS OF STRATOSPHERIC TRACE SPECIES **c46**
C. Camy-Peyret, J.-M. Flaud, and A. Perrin *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 179-186 Sponsored by INSU and CNES (For primary document see N92-24589 15-12)
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The LPMA (Limb Profile Monitor of the Atmosphere) instrument is a balloon borne Fourier transform interferometer based on a commercial BOMEM DA2 design. Its present operating capabilities cover the range 2.5 to 14 micrometers using liquid nitrogen cooled HgCdTe or InSb detectors. The maximum optical path difference achievable by the moving mirror is 50 cm leading to the theoretical apodized resolution of 0.020/cm. Technical details in the different subunits of the payload are presented together with their general accommodation into a medium weight gondola (approximately 400 kg). Scientific results of the last successful flights are discussed. ESA

N92-24621# Centre National d'Etudes Spatiales, Aire-sur-l'Adour (France). Centre de Lancement de Ballons Stratospheriques.
ARCTIC CAMPAIGNS **c43**
Pierre Faucon *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 187-193 (For primary document see N92-24589 15-12)
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Four years of balloon campaigns in the Arctic from 1987 to 1990 are considered. The necessary and essential information for those deciding to participate in this kind of campaign is given. This includes: the maximum operational performances to be expected during this kind of campaign, the loadable weight, the average flight time and the possible flight rhythm: the average cost per kilo of the experiment to be transported. ESA

N92-24622# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
IN SITU STRATOSPHERIC MINOR SPECIES MEASUREMENTS IN THE ARCTIC REGIONS UP TO 30 km ALTITUDES **c46**
P. Aimedieu, Y. Kondo, M. Koike, S. Iwasaki, D. Murcray, F. Murcray, W. A. Matthews, P. Johnston, W. R. Sheldon, and B. Sen (Houston Univ., TX.) et al *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 195-199 In FRENCH; ENGLISH summary Sponsored by CNES; Nagoya Univ.; Denver Univ.; Houston Univ.; and Dept.

of Scientific and Industrial Research (For primary document see N92-24589 15-12)
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During the CHEOPS 3 campaign (Jan. to Feb. 1990) several stratospheric balloons were flown in the polar stratosphere in the northern part of Scandinavia with scientific gondolas dedicated to the study of the chemistry of the medium up to 30 km altitude. One of them was flown two times, carrying instruments to measure simultaneously ozone, nitric oxides and acids, aerosols, and temperature. A typical set of measurements was obtained. The main results of this flight are presented. ESA

N92-24623# Forschungszentrum Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Atmosphaerische Chemie.
A NEW BALLOON BORNE STRATOSPHERIC HYGROMETER c35
U. Moerschel, E. Klein, D. Kley, and U. Schmidt *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 201-205 Sponsored in part by BMFT (For primary document see N92-24589 15-12)
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A balloon borne Fast In situ Stratospheric Hygrometer (FISH) is described. It was designed to allow measurements during a controlled balloon descent at a rate of 2 to 10 m/s and at day time as well as during the night. These features guarantee wide application because they allow joint flights with other instruments on the same balloon payload. A first test flight of the instrument was carried out from Aire sur l'Adour (southern France) on Nov. 10, 1990. Because the instrument was launched under very humid conditions, strong outgassing from both balloon and payload was observed during ascent and float. As soon as a descent speed of 2 m/s was reached the stratospheric water vapor mixing ratio could be measured. The profile shows a minimum of about 2 ppmv at 60 hPa (19.5 km) and values increasing up to 6 ppmv at 15 hPa (28.5 km). It will be compared to the methane profile which has been measured on the same gondola. ESA

N92-24624# Karlsruhe Univ. (Germany, F.R.). Inst. fuer Meteorologie und Klimaforschung.
REMOTE SENSING OF TRACE GASES WITH A BALLOON BORNE VERSION OF THE MICHELSON INTERFEROMETER FOR PASSIVE ATMOSPHERIC SOUNDING (MIPAS) c35
H. Oelhaf, T. v.Clarmann, F. Fergg, H. Fischer, F. Friedl-Vallon, C. Fritzsche, C. Piesch, D. Rabus, M. Seefeldner, and W. Voelker (Technische Univ., Munich, Germany, F.R.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 207-213 (For primary document see N92-24589 15-12)
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A novel cryogenic Fourier Transform Spectrometer (FTS) was developed for limb emission measurements in the mid IR region from balloon-borne platforms. Details of this spectrometer are given and the first two flights of the MIPAS balloon experiment are reported. During the first the spectral region 690 to 960 /cm was covered. The second flight took place with an additional filter region from 1160 to 1400 /cm. Limb emission spectra were collected from 33 km and 38 km floating altitudes covering tangent height between the middle troposphere and the float altitude. The trace gases CO2, H2O, O3, CH4, N2O, HNO3, N2O5, ClONO2, CF2Cl2, CFCl3, CHF2Cl, CCl4 and C2H6 have been identified up to now in the measured spectra. These gases play an important role in the ozone chemistry and/or climate system. ESA

N92-24625# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
A LIGHT UV-VISIBLE SPECTROMETER FOR ATMOSPHERIC COMPOSITION MEASUREMENTS BY SOLAR OCCULTATION c46
J. P. Pommereau, J. Piquard, and F. Goutail *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 215-218 (For primary document see N92-24589 15-12)
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A light ultraviolet (UV) visible spectrometer for investigating the chemistry of the atmosphere by solar occultation at sunset and sunrise, was designed. The microprocessor controlled instrument is able to perform measurements automatically without remote control and to transmit the compressed spectrometric data even with a low rate telemetry required for long distance transmission. The spectrometer will be used in 1991 and 1992 on board simplified and unexpensive balloons for regular soundings of the stratosphere and the upper troposphere at midaltitudes, and for the study of perturbed heterogeneous chemistry in the Winter Arctic stratosphere. The scale instruments will be flown later in 1993 on board long duration infra red Montgolfier balloons for investigating the troposphere stratosphere exchange in the tropical regions around the inner tropical convergence zone. ESA

N92-24626# Central Aerological Observatory, Dolgoprudnyi (USSR).
BALLOON MEASUREMENTS OF THE MIDDLE ATMOSPHERE PARAMETERS USING MICROWAVE SPECTROMETERS c46
A. A. Vlasov, E. N. Kadygrov, and M. G. Sorokin *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 219-222 (For primary document see N92-24589 15-12)
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A satellite microwave spectrometer operating at millimeter wavelengths is a useful instrument for measuring the stratospheric temperature and the minor constituents which are important for studies of stratospheric ozone destruction. The results of balloon measurements of the stratospheric temperature using 5 mm radiometer are presented. The radiometer has six channels with bands of 3 to 150 MHz and sensitivities of 0.6 to 0.9 K. The microwave spectrometer for determination of ozone concentration operating at 2.7 mm is described. ESA

N92-24627# Swedish Space Corp., Kiruna.
NEW FACILITIES AT ESRANGE (SWEDEN) c14
Alf Wikstroem and Boerje Sjoeholm *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 225-227 (For primary document see N92-24589 15-12)
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Esrange in the north of Sweden, managed by the Swedish Space Corporation, is supporting many satellite projects and is also a modern well established range for launching most types of sounding rockets, including high performance vehicles such as Terrier Black Brant, Skylark 12, and the new Castor 4B. At the range there are facilities for launching scientific stratospheric balloons of a size up to 600,000 cubic m. Due to more frequent and advanced rocket and balloon missions the scientific support at the range is continuously being upgraded. Real time presentation of Scandinavian Twin Auroral Radar Experiment (STARE) data is available, a new ionospheric sounder is installed at IRF at Kiruna, and meteorological support and new possible sites are examples of new facilities available at Esrange. ESA

N92-24628# Swedish Space Corp., Kiruna.
NEW TECHNIQUES USED FOR HIGH ALTITUDE SOUNDING ROCKETS AT ESRANGE (SWEDEN) c20
L. Marcus *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 229-230 (For primary document see N92-24589 15-12)
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High altitude sounding rockets are required mainly for microgravity experiments. A flight time of more than 10 minutes in

microgravity is necessary for these experiments. To achieve this, the payload must reach a peak altitude of nearly 1000 km. Guidance of the rocket trajectory is performed to avoid impact outside the assigned area and to allow a quick recovery operation, which is vital for the success and safety of the missions. Broad bandwith television video and Pulse Code Modulation (PCM) data transfers from the payload are used, in conjunction with the international telecommunications network to enable telescience operations to be performed from all over the world. ESA

N92-24629# Norwegian Space Center, Oslo.
AN INTEGRATED LAUNCH FACILITY FOR SOUNDING ROCKETS AND MICRO-SATELLITES **c14**
Rolf Skatteboe *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 231-236 (For primary document see N92-24589 15-12)
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The design of an integrated launch facility for small polar orbiting satellites and sounding rockets is presented with focus on the development of a cost effective total service for launch, operation and Telemetry, Tracking and Control (TTC) for microsatellites. A general TTC station located in Longverbyen on the island of Svalbard (Arctic) is proposed as a supplement to the Tromso satellite station (Norway). Such a station will give 100 percent ground coverage when high inclination satellites are tracked. It will also explore areas in which microsatellites can give significant scientific contributions. The design of a universal launch facility for sounding rockets and microsatellites is also discussed. The new pad is capable of launching rocket configurations of up to 20 tons, using elevation from 65 to 90 degree and azimuth of 20 to 260 degree. The proposed launch facility is based on the existing infrastructure of Andoya rocket range, the launch facility of the Norwegian Space Center. Due to the general development of satellite technology and the increasing demand for smaller satellites in dedicated orbits, this launch facility was verified for use in placing microsoatellites, with payloads up to about 150 kg, in polar or high inclination orbits from 550 km. ESA

N92-24630# Guidance Dynamics Corp., Simi Valley, CA.
SINGLE UNIT INTEGRATION OF INERTIAL INSTRUMENTATION, DATA PROCESSING, AND INPUT/OUTPUT DEVICES FOR CONTROL OF SOUNDING ROCKETS **c15**
Richard Eric Rasmussen and Richard A. Bailey *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 237-242 (For primary document see N92-24589 15-12)
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The advantages of integrating guidance, control and telemetry functions into a single unit, and how this was achieved through the development of the MARS TI (Miniature Attitude Reference System TRG (Tuned Rotor Gyros) Instrument) and MARS GC (Guidance Control) rollstable guidance platforms are discussed. The primary advantage of single unit packaging to the sounding rocket and commercial spacecraft user is a significantly lighter and less costly guidance and control overhead. Additional benefits include much more flexibility in the configuration of input and output devices, increased reliability through the reduction of discrete component interfaces, and reduced system weight and power consumption. The development process of both platforms is traced emphasizing the unique application of multifunction integrated circuits to solve packaging versus system capability design trades. Final product configuration flexibility is illustrated through applications examples. ESA

N92-24631# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.).
ON-LINE CALCULATION OF THE INSTANTANEOUS IMPACT POINT OF SOUNDING ROCKETS DURING FLIGHT **c15**
L. Altenbuchner and M. Hafner *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 243-246 (For primary document see N92-24589 15-12)
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The development of hardware and software for online calculation and presentation of the Instantaneous Impact Point (IIP) of sounding rockets is considered. This development is necessary for the safety system of guided sounding rockets with high trajectory apogees and small impact areas. Experiments were carried out and the results from sounding rocket flights with altitudes between 65 and 540 km are presented. The quality of IIP calculations is dependent on the tracking stations and tracking methods are demonstrated in different figures. ESA

N92-24632# Norwegian Space Center, Andenes. Andoeya Rocket Range.
NEW SERVICES AT ANDOYA (NORWAY) ROCKET RANGE **c14**
Ivar Nyheim *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 247-250 (For primary document see N92-24589 15-12)
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Recent developments at Andoya Rocket Range (ARR) (Norway) are presented. ARR is the launch facility of the Norwegian Space Center, used for sounding rockets and balloons. The range facilities and services are continuously being developed to satisfy the various users. Important recent projects comprise long duration balloon flights, airborne research, sea recovery and the Andoya geophysical datasystem for storage and distribution of ground based scientific measurements. ESA

N92-24633# Saab-Space A.B., Linkoeping (Sweden).
THE SPINRAC SYSTEM: CONTROL OF EXOATMOSPHERIC VEHICLES **c20**
L. Hall and A. Helmersson *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 251-255 (For primary document see N92-24589 15-12)
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The Spinning Rocket Attitude Control (SPINRAC) system for guidance of exoatmospheric sounding rockets is described. The main objective for this system is the impact dispersion reduction making it possible to launch apogees of about 1000 km at launch sites with small impact areas. The SPINRAC main features are the low gas consumption and short guidance time, both contributing to higher apogee altitudes. Typically 20 degrees of repointing and damping of 10 degrees half cone angle is performed in less than 20 s. The SPINRAC is easily adaptable to other applications. The standard system, its components and the first flights are described. ESA

N92-24634# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
ULTRA-SMALL SATELLITE AND LAUNCH VEHICLE **c15**
H. Matsuo, T. Hayashi (Chiba Inst. of Tech., Narashino, Japan), and H. Saito *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 257-260 (For primary document see N92-24589 15-12)
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An idea of a very small satellite launcher and a very small satellite is presented. The launcher is a three stage solid rocket based on a Japanese single stage sounding rocket S-520. Its payload capability is estimated to be 17 kg into 200,000 km elliptical orbit. The spin stabilized satellite with Sun pointing capability, though small, has almost all functions necessary to usual satellites. In its design, universality is stressed to meet various kinds of mission interface requirements and it can afford 6 kg to mission instruments. ESA

N92-24635# Centro Tecnico Aerospacial, San Jose dos Campos (Brazil). Inst. de Aeronautica e Espaco.
DEVELOPMENT STATUS OF THE BRAZILIAN VLS SATELLITE LAUNCHER PROGRAM **c15**
Jayme Boscov, Paulo Moraes, Jr., Ariovaldo F. Palmerio, Luis R. DelMonaco, Benedito M. P. Furlan, and Toshiaki Yoshino *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 261-267 (For primary document see N92-24589 15-12)
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An overview of the Vanderberg Launch and landing Site (VLS) satellite launcher, part of the Brazilian Space Program, is given. The following are presented: the general concept; constuctural and performance characteristics of the vehicle; the development status in many fields such as vehicle engineering, manufacturing, tests and facilities. ESA

N92-24636# British Aerospace Public Ltd. Co., Bristol (England). Earth Observation and Science Div.
THE SKYLARK SOUNDING ROCKET PAST AND FUTURE PROJECTS **c20**
J. A. Ellis *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 269-272 (For primary document see N92-24589 15-12)
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The Skylark launches are described from Apr. 1989 up to the present date, with the performance data of typical launchers. The launches all took place at the Swedish Space Corporation launch Site Esrange. The current Skylarks available, the Skylark 5.7 and 12 and the possibilities of combining current motors with U.S. boost motors offering a wider range of performances, are described. ESA

N92-24637# Centre National d'Etudes Spatiales, Toulouse (France). Balloon Div.
THE MEDIUM-TERM DEVELOPMENT OF EARTH BALLOON ACTIVITIES IN FRANCE
M. Audebert *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 275-278 (For primary document see N92-24589 15-12)
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Factors concerning the medium term Earth balloon program are analyzed: the requirements of the scientific community; the changes of the environment in which programs are carried out; the state of balloon technology and its possible development. An Earth balloon program is presented. ESA

N92-24638# Centre National d'Etudes Spatiales, Aire-sur-l'Adour (France). Centre de Lancement.
ACTIVITIES OF CNES STRATOSPHERIC BALLOON LAUNCHING CENTER, 1989-1990 [L'ACTIVITE DU CENTRE DE LANCEMENT DE BALLONS STRATOSPHERIQUES DU CNES ANNEES 1989-1990]
P. Vincent *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 279-285 (For primary document see N92-24589 15-12)
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An evaluation of the stratospheric balloons activities from 1982 to 1990 is presented, reporting the number of annual flights, the payloads carried, the distribution, of experiments by discipline, and the launching periods. The scientific and technological programs carried out between 1989 and 1990 are presented. ESA

N92-24639# Centre National d'Etudes Spatiales, Toulouse (France).
LARGE HEAVY DUTY BALLOONS IN EUROPE **c02**
J. P. Diris *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 287-289 (For primary document see N92-24589 15-12)
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For 14 years now, the large stratospheric ballons are regularly operated by the so called ODISSEA organization, above the western Mediterranean sea. During that period, almost 50 flights have been performed for the benefit of scientific institutes of the three organizing agencies and other European countries. Performances in all fields are constantly increasing; the maximum suspended payload reaches now 2600 kg, and it is flown with balloons in the range of 14 million cu m. Equipments performances follow the same path in order to match the growing demand of the experiments. Main technical aspects (including launching equipment, flight control equipment, materials used) are presented along with future programs; either in Europe, or in the Southern Hemisphere (Australia). ESA

N92-24640# Raven Industries, Inc., Sioux Falls, SD.
RECENT DEVELOPMENTS IN THE USE OF THIN-FILM POLYETHYLENE BALLOONS FOR METEOROLOGICAL APPLICATIONS **c02**
Tim W. Markhardt *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 291-294 (For primary document see N92-24589 15-12)
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Prompted by the availability of reliable thin polyethylene films (6 to 9 micrometers), a balloon was developed which provides more dependable high altitude data for meteorological soundings than a latex balloon. The performance of these balloons is presently being verified by users in both Arctic and the Antarctic regions. Data is presented which examined the rise rate and ultimate attitude performance of the balloon. Performance of a series of balloons using the newly designed Kjome vent-down device is presented. An economical method of controlling the descent of a sounding balloon after the desired ascent portion of the flight has been attained, was developed. The balloon model used in the project was a 9 micrometers 538 cu m polyethylene balloon. Payload on the balloon was nominally 6.0 kg. Altitude attained was nominally 11 mb. Experiments have been conducted in both the Arctic and Antarctic regions. Flight data obtained during a 1991 campaign, where the target descent rate was 4 m/sec, is presented. ESA

N92-24641# Italian Space Agency, Rome. Milo Stratospheric Balloon Launch Base.
GROUND IMPACT POINT FORECAST FOR STRATOSPHERIC BALLOON FLOATING PAYLOAD **c02**
O. Cosentino and J. C. Varlet (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 295-298 (For primary document see N92-24589 15-12)
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Starting from meteorological (radiosonde) telemetry data; a forecast method of the impact point of a stratospheric scientific payload, upon separation, during floating flight is illustrated. The program chooses the separation moment for an easier payload recovery. The calculation is made with the least square method starting from a polynomial, in longitude and latitude variables, whose unknown quantities are represented by coefficient Chebyshev polynomials until the fourth degree. Such fitting produces a series of equations one for each isobaric surface, representing the geopotential state on the area over which the stratospheric flight will take place. The knowledge of the geopotential mathematical function over the whole balloon action area, assuming the geostrophic case provides the vertical profile of the winds in every point. Knowing the descent trajectory and relevant impact point, during the flight, especially in case of the blowing up of the balloon, makes the research easier on the ground or in the sea. ESA

N92-24642# Centre National d'Etudes Spatiales, Toulouse (France).
AEROSTAT FOR THE MARS 1994/1996 MISSION [L'AEROSTAT DE LA MISSION MARS 94/96] **c91**
C. Tarrieu *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 301-305 In FRENCH (For primary document see N92-24589 15-12)
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An original vehicle, the Aerosat, to be used as a means of locomotion, either near the Mars surface during atmospheric flight at a few kilometers altitude, or directly in contact with the ground when the Aerosat will be stabilized by its guiderope, is presented. A general description of the mission is given and concepts for the design of the balloon together with its dimensions and technological aspects are discussed. ESA

N92-24643# Winzen International, Inc., San Antonio, TX.
NYLON 6 SUPERPRESSURE BALLOONS **c02**
J. L. Rand, L. G. Seely, T. L. Lew, and M. S. Smith *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 309-313 (For primary document see N92-24589 15-12)
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The material selection process and the development of a new fabrication method for stratospheric superpressure balloons are outlined. An adhesive tape sealing method was developed for fabrication of balloons with nylon 6. These new procedures were used for the construction of two small prototypes and two balloons 23.2 m in diameter. The first balloon was thoroughly inspected in an indoor full inflation test. After inspection, the balloon was deflated and delivered to a launch site where the first test flight was conducted. The balloon had ascended to its float altitude when an electronic malfunction caused a premature termination of the flight. An attempt to launch a second balloon on 8 Feb. 1991 resulted in a canceled flight due to damage sustained during balloon inflation. The details of the damage and the subsequent changes are described. The future of superpressure balloon design and contruction is discussed with special attention made to newly available materials. ESA

N92-24644# Centre National d'Etudes Spatiales, Toulouse (France).
APPLICATION OF LIMIT FLYING BALLOONS TO THE STUDY OF THE PLANETARY BOUNDARY LAYER [APPLICATION DES BALLONS PLAFONNANTS A L'ETUDE DE LA COUCHE LIMITE PLANETAIRE] **c46**
B. Dartiguelongue, P. Malaterre, B. Benech, A. Hammam, and A. Druilhet (Toulouse Univ., France) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 315-320 In FRENCH (For primary document see N92-24589 15-12)
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The modeling of low altitude balloons capable of flying in the planetary boundary layer for several days, carrying scientific instruments to measure significant thermodynamics, is considered. The behavior of pressurized balloons of different shapes, in dynamic waves and atmospheric turbulence, was modeled, taking account of convective and radiative thermal effects. The validity of these simulations was tested in experimental data of the Autan 84 and Pyrex 90 campaigns. ESA

N92-24645# Centre National d'Etudes Spatiales, Toulouse (France). Div. Ballons.
THE CONCEPT OF A LONG DURATION STRATOSPHERIC BALLOON [CONCEPT D'UN BALLON STRATOSPHERIQUE OUVERT DE LONGUE DUREE] **c02**
Christian Tockert *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 321-325 In FRENCH (For primary document see N92-24589 15-12)
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The design of a new type of stratospheric balloon which can maintain a stable flight level at night without resorting to dropping the ballast is considered. The approach taken is to cover the upper part of the balloon with an insulating cape, the equivalent to 3 pct. of the total diurnal surface. During the night descent, the volume decreases and the cape tends to cover a greater percentage of the gas moistened surface until 50 pct. is reached. Even under several radiative conditions, this configuration improved the thermal balance of the balloon and stabilized it in the low stratosphere. As soon as the Sun comes out, the balloon regains its diurnal flight level. In this way numerous day night cycles are repeated. A three week flight does not seem impossible. ESA

N92-24646# Centre National d'Etudes Spatiales, Toulouse (France). Div. Ballons.
ALTITUDE EXCURSION CONTROLLED BALLOON FOR LONG DURATION FLIGHT [BALLON A EXCURSION D'ALTITUDE COMMANDEE POUR VOL LONGUE DUREE] **c02**
V. Dubourg and P. Malaterre *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 327-331 In FRENCH (For primary document see N92-24589 15-12)
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Flight dynamics of the Infrared flux capturing Montgolfier (IRM) are recalled and present IRM performances are summarized. The IRM is a long duration flight balloon which uses infrared solar and terrestrial flux to heat the air sustaining it. Numerical modeling of the following is presented: valve and sleeve cover IRM flying at middle and equatorial latitudes for equatorial stratospheric sounding; small pole valve IRMs, for vertical soundings in polar region during Summer, the duration of the polar day at this period giving long duration flights with low volume (less than 10,000 cu m) balloons, for monitoring air masses and analyzing polar atmospheric boundary composition. ESA

N92-24647# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (Germany, F.R.).
F-CORONA-EXPERIMENT: REQUIREMENTS FOR REMOTE SENSING OF INTERPLANETARY DUST **c90**
Ingrid Mann and Hermann Hartwig *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 335-337 (For primary document see N92-24589 15-12)
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The near solar dust that produces the brightness of the F corona represents the central region of the interplanetary dust cloud. The structure of the inner dust cloud and the properties of the near solar dust contribute to the understanding of the meteoritic complex and its relation to other constituents of the interplanetary medium. The flux rates of these micrometeorites have to be considered for the concept of near solar missions. To investigate this complex a synoptical observation in different spectral ranges is needed. The concept of the dedicated rocket-borne experiment is outlined. ESA

N92-24648# Bonn Univ. (Germany, F.R.). Inst. fuer Astrophysik und Extraterrestrische Forschung.
CONTAMINATION OF TERRESTRIAL EUV OBSERVATIONS BY ENERGETIC PARTICLES **c93**
G. Lay, H. U. Nass, and Hans J. Fahr *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 339-342 (For primary document see N92-24589 15-12)
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On Sep. 3 1988 at 14.10 UT the payload Interzodiac 2 was carried out onboard Skylark 12, from Natal, Brazil, to an apogee

of 857 km. This mission was aimed at the observation of interplanetary and geocoronal Extreme Ultraviolet (EUV) resonance radiation, especially at 58.4 nm (He) and 121.6 nm (H). During the 16 minute flight an unexpectedly high background signal was registered. A first analysis already showed that this signal could not be explained as resonance radiation. A Japanese mission launched in 1970 from Japan registered a comparably intense signal, however at much higher altitudes. The comparison with these data and with some earlier results obtained at Natal in 1967 allowed the background signal to be identified due to high energetic particles trapped in the magnetic field of the Earth.
ESA

N92-24649# Bonn Univ. (Germany, F.R.). Inst. fuer Astronomie.
OBSERVATION OF THE SOLAR LYMAN-ALPHA LINE c92
H. U. Nass, G. Lay, and Hans J. Fahr *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 343-347 (For primary document see N92-24589 15-12)
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On Aug. 23, 1989 at 18.05 UT the payload Solly was carried onboard a Black Brant 9 rocket from White Sands Missile Range (U.S.) to an apogee of about 330 km. The experiment consists mainly of a hydrogen cell with channeltron mounted sideways of the main optical axis. By only measuring the scattered Lyman alpha photons, it is possible to study in detail the core region of the solar Lyman alpha line. The experiment was flown on Oct. 24 1988 for the first time. The data sets of this flight showed a very high background signal and in order to improve the signal/noise ratio in the next flight, a Lyman alpha interference filter was mounted in front of the channeltron detector. The effect of this filter is presented. Up to now the data sets were evaluated by simulating the photon flux by means of a Monte Carlo technique, which is a very time consuming computer method. An analytical approximation was evaluated, and a comparison of both methods is given. ESA

N92-24650# Bonn Univ. (Germany, F.R.). Inst. fuer Astrophysik und Extraterrestrische Forschung.
THE PROBLEM OF THE OXYGEN PRESENCE IN THE HELIOSPHERE AND OBSERVATIONAL IMPLICATIONS c92
Hans J. Fahr *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 349-354 (For primary document see N92-24589 15-12)
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Due to the relative motion of the solar system with respect to the ambient interstellar medium (VLISM) neutral atomic VLISM gases can pass over the plasma interface region ahead of the solar system and can enter into the inner heliosphere, however, only after having suffered changes in their dynamic and thermodynamic properties. VLISM oxygen especially is subject to strong charge exchange loss processes, uncompensated by corresponding gain processes, before it enters the inner heliosphere. Thus, the presence of VLISM oxygen in interplanetary space is crucial for the type of plasma interface ahead of the solar system which sensitively determine the net oxygen inflow. It is proposed to observe the interplanetary oxygen resonance glow intensity at 1304 A with a rocket or Space Shuttle-borne experiment in order to clarify the nature of this interface. For this purpose, detector sensitivities enabling a positive detection of intensities down to 0.001 Rayleighs are required. These sensitivities are reached by an instrument called Hitch-Helly which is developed for a forthcoming Hitchhiker flight. ESA

N92-24651# Geneva Observatory (Switzerland).
NEW POINTING TECHNIQUES FOR BALLOON BORNE TELESCOPES Abstract Only c89
D. Huguenin *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 355 (For primary document see N92-24589 15-12)
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The conclusion after 30 years of balloon astronomy is that the stabilization of balloon-borne telescopes requires very specific solutions. Gondola and telescope structures must be light. Consequently, they are not rigid and have low resonance frequencies. In such a mechanical environment, high gain tracking servo-systems are unstable. The faintest phase lag in the tracking loop sustains compound pendulum oscillations of the gondola telescope system. The simple and economical solution of these problems by modern control techniques is shown, and the extensive verification of these concepts over 13 flights with 4 gondolas carrying telescopes up to 60 cm or large stabilized solar platforms is described. The pointing stability is typically 3 inches RMS.
ESA

N92-24652# Geneva Observatory (Switzerland).
NEW CONCEPTS AND PERFORMANCES IN AZIMUTH CONTROL OF LARGE BALLOON GONDOLAS c02
F. P. Wildi *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 357-361 Sponsored by CNES; Swiss Foundation for Scientific Research; and Geneva Univ. (For primary document see N92-24589 15-12)
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A new type of azimuth bearing to be used for orientation and stabilization of balloon gondolas is described. This device was developed for the rather heavy (2.5 tons) French PRONAOS experiment but it can be used for any experiment which needs performant azimuth control. Instead of using a classical activated ball thrust bearing, the bearing is torque controlled. Besides providing weight economy and mechanical simplification over classical systems, it overwhelms some of their intrinsic defaults: high variation of azimuth loop gain versus temperature, low maximum torque, and above all, high electrical consumption. A technical description is given and test results obtained on a model at the Geneva Observatory show that the prototype works down to -60 C with no significant loss in performances thus achieving a 95 percent linearity over the +/- 4.5 Nm domain, a 0.02 Nm sensitivity while consuming 17 W, that is to say 1/10 of what was previously needed by activated bearings. ESA

N92-24653# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Inst. d'Astrophysique Spatiale.
PHOTOSPHERIC LINES REDSHIFT FROM BALLOON ULTRAVIOLET SPECTRA OF THE QUIET SUN c92
D. Samain *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 363-366 Prepared in cooperation with Paris VI Univ., Fran ce (For primary document see N92-24589 15-12)
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Wavelength shifts between solar photospheric lines observed in two quiet areas of the Sun and telluric O2 absorption lines of the Schulman-Runge bands were measured in the 1950 to 2000 A region. The results are deduced from high resolution spectra taken on board a balloon experiment at an altitude of 39 km. They show a systematic redshift of the solar lines relative to the reference telluric spectrum. After correction for the gravitational redshift and for all the known relative motions between Sun and observer, the average residual value is +7 mA, that corresponds in terms of velocity to an equivalent Doppler-Fizeau shift on the whole spectrum of about 1 km/s away from the observer. Whether the redshift has a solar origin or the O2 telluric lines are blueshifted in the terrestrial atmosphere is considered ESA

N92-24654# Wuppertal Univ. (Germany, F.R.). Dept. of Physics.
DYANA PROJECT SURVEY c46
D. Offermann *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov.

1991 p 369-386 (For primary document see N92-24589 15-12)
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Dynamics Adapted Network for the Atmosphere (DYANA) was an international campaign of coordinated ground based, balloon, and rocket borne measurements for the study of middle atmosphere dynamics. It was performed in January through March 1990 in the Northern Hemisphere. A large network of measuring stations was operated, including 70 ground based experiments, 95 ozonsonde and 326 radiosonde releases, and 269 rocket launches. Scientists from twenty countries participated in the campaign. Scientific objectives, campaign structure, and performance of measurements are described. ESA

N92-24655# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (Germany, F.R.).
SOME NEW OBSERVATIONS AND RESULTS OBTAINED BY THE FOIL CHAFF TECHNIQUE: VERY HIGH WIND VELOCITIES AND SOLITARY WAVES IN THE MESOSPHERE **c46**
H.-U. Widdel *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 387-389 (For primary document see N92-24589 15-12)
(Contracts BMFT-01-OE-0610; BMFT-01-OE-86033; BMFT-01-OE-88042)
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Flow separations seen on foil chaff experiments at heights below 90 km were found to be caused by solitary waves of elevation. Their travel velocity is of the order of 100 m/s and their amplitude is of the order of 1 km which is about 1/4 of their wavelength. Solitary waves of depression seem to travel much faster. The sample shown had a velocity of about 200 m/s and traveled from south south west towards north north east at a height of 87 km. Compared to what was observed in the troposphere, the travel velocities of solitary waves were observed in winter, summer, and autumn, but remained rare events: from 65 experiments solitary waves were observed on five flights only but this might have been an experimental effect because certain conditions have to be met to observe such events. ESA

N92-24656# Academia Sinica, Beijing (China). Inst. for Space Sciences and Technology.
TURBULENCE SPECTRUM OBSERVED ON A FOIL CLOUD EXPERIMENT LAUNCHED ON 22 FEBRUARY 1991 1906 UT AT BISCARROSSE, SOUTHWEST FRANCE (44 DEG N, 1 DEG W) **c46**
Yong-Fu Wu and H.-U. Widdel (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany, F.R.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 391-392 (For primary document see N92-24589 15-12)
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The power spectrum of the vertical velocity of air measured by a foil cloud experiment launched during campaign Dynamics Adapted Network for the Atmosphere (DYANA) was calculated from the vertical velocity of air measured by this experiment for the height interval in which an extremely high horizontal wind velocity and a large shear of wind was observed, around 87 km altitude. As expected, the spectrum shows that turbulence was present but the spectrum shows two regions: one at lower frequencies (less than 0.25 Hz) which has a slope of -1.65 (this is close to -5/3 expected for one dimensional spectrum of density fluctuations in an inertial subrange of homogeneous isotropic turbulence) and a break at a length scale of about 70 m where the slope changes to approximately -7.11 (viscous subrange). This observation is in good agreement with previous results where a break in the spectral slope around a length scale of about 30 m on one of these flights was found. The turbulence energy dissipation rate was calculated from the spectrum and was found to be 0.87 W/kg. This value is higher than those obtained from foil experiments flown in the winter of 1983/84 but still fits to data obtained by Luebken et al for this height region. ESA

N92-24657# Bonn Univ. (Germany, F.R.). Inst. fuer Physik.
DETERMINATION OF RICHARDSON NUMBERS IN THE MESOPAUSE REGION **c46**
A. Bacher and U. vonZahn *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 393-397 (For primary document see N92-24589 15-12)
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The Richardson number (Ri) is used to assess fluid instability and its ability to generate turbulence. Concerning the conditions for instability of mesospheric small scale flows, gravity waves play an important part. Hence, experiments aimed at the determination of profiles of the Ri require a height resolution good enough to resolve vertical scales on the order of a kilometer. Potentially, a combination of groundbased lidar temperature measurements with in situ wind measurements through foil chaff clouds should allow determination of the height dependence of Ri in the mesopause region. Results of an initial experiment of this kind are presented. ESA

N92-24658# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (Germany, F.R.).
SIMULTANEOUS RADAR AND LIDAR OBSERVATIONS DURING THE DYANA-CAMPAIGN **c46**
P. Czechowsky, B. Inhester, J. Klostermeyer, R. Ruester, and G. Schmidt *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 399-405 (For primary document see N92-24589 15-12)
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During the Dynamics Adapted Network for the Atmosphere (DYANA) campaign from Jan. - Mar. 1990 the SOUSY-VHF-Radar and the SOUSY-UV-Lidar were operated simultaneously at 15 clear nights near Andenes on the island of Andoya (northern Norway) to investigate the structure and dynamics in the polar atmosphere. Density and temperature profiles derived from Rayleigh backscattering in the height range from about 30 to 90 km are presented with a comparison of datasonde results, and the relation to wind shear variations deduced from radar observations. The Richardson number, which is a criterion for atmospheric stability and in turn for the generation of scattering layers, was calculated from the temperature gradient and from the wind shear. In particular, the event on 7 Mar. demonstrated that the detected echo structure results from upward propagating gravity waves causing superadiabatic lapse rates and finally a series of turbulence bursts. ESA

N92-24659# Freie Univ., Berlin (Germany, F.R.). Inst. fuer Meteorologie.
A NOTE ON THE INTERANNUAL VARIABILITY OF THE POLAR VORTEX IN THE ARCTIC **c46**
K. Labitzke *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 407-411 (For primary document see N92-24589 15-12)
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The intensity of the Arctic polar vortex in winter appears to be affected by the state of the Quasi-Biennial Oscillation (QBO) in the equatorial stratospheric wind. Recent model experiments substantiate this observation. The theoretical association between the QBO and the vortex should be cold and intense; with an easterly QBO it should be weaker and warmer. It has been observed, however, that this relationship fails during maxima in the 11 year solar cycle. The recent stratospheric winters, including that of the DYANA campaign, are discussed in this context. ESA

N92-24660# Swedish Inst. of Space Physics, Lycksele.
MEASUREMENTS FROM THE EISCAT RADAR DURING DYANA **c46**
S. Kirkwood, T. Blix, U.-P. Hoppe, I. Haeggstroem, and U. vonZahn (Bonn Univ., Germany, F.R.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 413-418 (For primary document see N92-24589 15-12)
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The EISCAT radar was operated during the Dynamics Adapted Network for the Atmosphere (DYANA) campaign with the primary aim of studying winds in the 80 to 120 km altitude interval. Measurements were made on 15 evenings and 4 mornings between 19 Feb. - 14 Mar. 1990. The dominant winds seen during the observation period correspond to the semidiurnal tides, with amplitudes sometimes in excess of 100 m/s. In addition to winds, plasma densities, plasma temperatures, magnetospheric electric fields, and in favorable circumstances neutral densities, were also measured. These provide a monitor of the auroral activity and allow the study of a number of effects which result from the sometimes very strong electric fields (exceeding 80 mV/m). One effect of the even more moderate electric fields is the formation of sporadic E layers, which were observed on several occasions twice simultaneously with sudden sodium layers. Another effect, particularly of the most intense electric fields, is strong heating of the electrons between 100 and 120 km altitude, which was observed on a large number of occasions, including during a Turbo launch. Strong plasma turbulence was then observed by the Turbo instruments in the same height interval as the electron heating. ESA

N92-24661# Instituto Nacional de Tecnica Aeroespacial, Huelva (Spain). El Arenosillo Sounding Range.
COUPLING STRATOSPHERE-LOWER IONOSPHERE AT MIDDLE LATITUDES **c46**
B. A. delaMorena, F. Caballero, and A. Gimenez *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 419-422 (For primary document see N92-24589 15-12)
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A study on the coupling of the stratosphere and the lower ionosphere during winter periods, supported by analysis of wind, stratospheric temperature, and ionospheric absorption in the D region, obtained at El Arenosillo (southern Spain) is presented. Superloki datasondes with rocket launchings and A-3 absorption measuring equipments were used. A clear difference between the coupling phenomena shown in southwest and central Europe was revealed. ESA

N92-24662# Wuppertal Univ. (Germany, F.R.). Dept. of Physics.
ROCKET-BORNE INFRARED MEASUREMENTS IN THE ARCTIC UPPER ATMOSPHERE **c46**
K. U. Grossmann, D. Homann, and J. Schulz *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 423-427 (For primary document see N92-24589 15-12)
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In Spring 1990 and 1991 and in Summer 1990 the SISSI program (Spectroscopic Infrared Structure Signatures Investigation) was carried out over Esrange, Kiruna (Sweden). Four Skylark payloads were successfully launched. The main experiment of each payload was a liquid helium cooled infrared spectrometer which measured the thermal infrared emission from the Arctic mesosphere and lower thermosphere. The recorded spectra will be used to determine trace gas densities in the mesosphere and to study excitation processes in the mesopause region and above. ESA

N92-24663# Phillips Lab., Hanscom AFB, MA. Geophysics Directorate.
TWILIGHT MEASUREMENTS OF HIGH-LATITUDE ATMOSPHERIC MINOR SPECIES DURING THE DYANA CAMPAIGN **c46**
A. Ratkowski and J. Ulwick (Utah State Univ., Bedford, MA.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 429-435 (For primary document see N92-24589 15-12)
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During the Dynamics Adapted Network for the Atmosphere (DYANA) campaign, a rocket containing a resonance fluorescence experiment for measurement of atomic oxygen concentrations was launched at twilight dawn from Esrange, Kiruna, Sweden. The measured atomic oxygen concentration achieved a peak value of 6 x 10 exp 11 atoms /cu cm between 90 to 105 km. Ground based, near infrared spectral measurements for the hydroxyl (OH) airglow emissions were made from which OH Meinel (3-1) band intensities, and rotational temperatures were obtained. During the MAP/WINE campaign in Feb. 1984, similar measurements using identical rocketborne and groundbased techniques were made at night from Esrange. These measurements and the DYANA measurements are discussed and compared to model calculations. ESA

N92-24664# Norwegian Defence Research Establishment, Kjeller.
MIDDLE ATMOSPHERE TURBULENCE AT HIGH AND MIDDLE LATITUDES **c46**
T. A. Blix and E. V. Thrane *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 437-442 (For primary document see N92-24589 15-12)
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In situ measurements of plasma density fluctuations at high and middle latitudes are used as passive tracers for motions in the nonionized air. Quantitative estimates of the characteristics of turbulence in the mesosphere and lower thermosphere were derived. The results show a characteristic minimum in turbulent intensity at or below the mesopause region. The data show that fluctuations in plasma density are consistent with fluctuations in neutral density. ESA

N92-24719# European Space Agency, Paris (France).
SPACECRAFT FLIGHT DYNAMICS
James J. Hunt, ed. Dec. 1991 596 p The 3rd international symposium was held in Darmstadt, Fed. Republic of Germany, 30 Sep. - 4 Oct. 1991
(ESA-SP-326; ISBN-92-9092-146-3; ISSN-0379-6566; ETN-92-91274) Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

The papers from sessions on the following are presented: geostationary co-location; celestial mechanics; accuracy and precise estimation; orbit related experience; attitude related experience; geostationary mission aspects; spacecraft dynamics and control; more than one spacecraft; mission and orbit design; mission descriptions. The variety of topics and the range of institutes represented testify to the wide scope and ever changing nature of flight dynamics. Operational experience plays a dominant role and is reflected in the number of papers chosen from this area. The broad program closed the circle joining theory, design and experience. For individual titles, see N92-24720 through N92-24790.

N92-24720# CISI Ingenierie, Toulouse (France).
ANALYSIS OF SEPARATION STRATEGIES FOR CO-LOCATED SATELLITES **c18**
Luc Maisonobe and C. Dejoie *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 5-9 (For primary document see N92-24719 15-12)

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A statistical method that was successfully used to compute the collision risks between two colocated geostationary satellites is described. The properties of extremal distance series are exposed. The properties are too inaccurate to allow an immediate use of this series in the statistic tools, and the required filtering is described. Two methods were used to find the distribution law, the classical extrema method, and the so called 'renewal' method derived from the flood analysis theory. These methods were applied to different separation strategies. The application revealed that if separation strategies are necessary, all separation methods are efficient. Also, there is no need to use simultaneous maneuver for the satellites of the cluster, thus decreasing the implementation constraints. ESA

N92-24721# Satellite Operational Services G.m.b.H., Gilching (Germany, F.R.).

APPROACH TO THE EVALUATION OF INTERFERENCES BETWEEN CO-LOCATED GEOSTATIONARY SPACECRAFT **c18**

Alexander Haerting *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 11-16 (For primary document see N92-24719 15-12)

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Interferences other than collisions between colocated geostationary satellites are addressed. These may result in shadowing and disturbances of the radio frequency link or attitude sensors. A software tool for computing line of sight geometries is introduced. Applications to orbit simulations of currently accepted candidates for colocation strategies are presented and evaluation criteria are discussed. Quantitative statements about the significance of interferences are not made, but it seems that additional limits on the separation parameters may arise for some strategies. ESA

N92-24722# Telespazio, S.p.A., Rome (Italy).

AN ECCENTRICITY CONTROL STRATEGY FOR COORDINATED STATION KEEPING **c18**

S. Carlini and F. Graziani (Rome Univ., Italy) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 17-21 (For primary document see N92-24719 15-12)

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The growth trend in telecommunications is such as to lead to a crowding of the geostationary orbit and to remarkable increases in the satellite dimensions to satisfy payload requirements. This joined with increases of the costs and risk factors, is producing the study and the development of opportune alternatives. To make the use of the geostationary orbits more efficient, several satellites could be colocated at the same longitude deadband. The increase in the satellite capacity will soon lead to exceed the capability of present and planned launch vehicles. To avoid this, the concept of the satellite cluster proposes to divide the payload into several parts, and for each of them to design and develop an adequate satellite. It is possible to guess that the evolution of spaceborne communication system will have a direct impact upon the station keeping strategy. A coordinate station keeping strategy to maintain more than one satellites cluster in the same window is proposed. ESA

N92-24723# Centre National d'Etudes Spatiales, Toulouse (France).

ONE YEAR OF CO-LOCATION AT 19 DEGREES WEST WITH TDF1 AND TDF2 SPACECRAFTS **c18**

Francoise Dufor *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 23-25 (For primary document see N92-24719 15-12)

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Colocation keeping several satellites on the same nominal position has become reality and the demand for it will grow in the near future. The control centers of such satellites are charged with ensuring a safe separation of such colocated satellites. The positioning of the first French communication spacecraft TDF1 was completed on Dec. 5, 1988 at 19.0 +/- 0.1 degrees west. Since then the satellite is kept on station by the present orbit separations team. On Aug. 5, the first spacecraft, Olympus, of the new generation of communication satellites joined this position at 19.0 +/- 0.1 degrees west. A third satellite, the German spacecraft TVSAT-2, whose positioning was completed on Aug. 22, 1989 at 19.2 +/- 0.1 degrees west. The last one to join the position at 18.8 +/- 0.1 degrees west was the second French Telecommunication spacecraft TDF2 on Aug. 9, 1990. The different strategies applied to perform the stationkeeping in safe conditions, the operational constraints and the overcosts due to the 'colocated strategy' are described. ESA

N92-24724# Mathematischer Beratungs- und Programmierungsdienst G.m.b.H., Dormund (Germany, F.R.). Software and Systems Div.

PHOTOGRAPHIC OBSERVATIONS OF THE CO-LOCATED SPACECRAFT AT 19 DEG WEST **c18**

Hermann Boehnhardt *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 27-32 (For primary document see N92-24719 15-12)

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During an asteroid astrometric campaign conducted Apr. 10-22, 1991 at the European Southern Observatory (ESO) in La Silla (Chile), subsidiary observations were made of geostationary satellites positioned above 19 deg west longitude using the 40 cm GPO astrograph. These observations, recorded on 2 by 2 deg field of view photographic plates, clearly show the presence of TDF-1 and 2 (18.7 to 18.9 deg west), Olympus (18.9 to 19.1 deg west) and TV-SAT-2 (19.1 to 19.3 deg west) positioned about this point. The exposures demonstrate the changes in the relative positions of the satellites due to drift motion and orbital maneuvers. The observations of Apr. 17-22, 1991 also document the deadband violation of Olympus which drifted through the TDF longitude window. On Apr. 22, 1991, a multiple exposure of the 19 deg west geostationary longitude was collected. Eleven 5 minute exposures, each separated by 60 or 30 minutes, were obtained in a single photographic plate, thus recording the daily libration of the satellites as well as their brightness variation due to changing solar illumination. At least three other geostationary or near geostationary objects are visible in this plate, hence identified as 1983-47-A or Intelsat 5 F-6 1988-71-D part of the launch of Gorizont 16 and 1990-112-D upper stage of the Raduga 26 launch. The exposures may support calculations of angular separations between the satellites to an accuracy of the order of 1 to 2 arcsec, corresponding to 200 to 400 m projected intersatellite distance in geostationary orbit. ESA

N92-24725# Universidad Politecnica de Barcelona (Spain). Departament de Matematica Aplicada y Analisi.

A QUASIPERIODIC SOLUTION AS A SUBSTITUTE OF L4 IN THE EARTH-MOON SYSTEM **c90**

Gerard Gomez, Angel Jorba, Josep Masdemont (Universidad Politecnica de Catalunya, Spain), and C. Simo *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 35-41 (For primary document see N92-24719 15-12)

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The Earth-Moon-particle system is considered as a Restricted Three Body Problem (RTBP). It is well known that there are two equilateral libration points. In the real life system, these points do not exist, due to the effects of the perturbations caused by the part of the solar system which is not taken into account. Assuming that the real motion of the solar system is quasiperiodic, it is possible to write the full problem as a quasiperiodic time dependent perturbation of the RTBP. A quasiperiodic with the same basic frequencies as the perturbation, and such that it goes to zero when the perturbation does, is then looked for. This orbit can be seen as a dynamical equivalent of the point. This orbit is computed for a simplfied model of the kind described before, and refined to be a numerical solution of the best available model. The stability of this orbit is studied, showing a very mild unstability. ESA

N92-24726# Adam Mickiewicz Univ., Poznan (Poland). Astronautical Observatory.
PRECISE ANALYTICAL THEORY OF AN ARTIFICIAL SATELLITE MOTION IN THE GRAVITY FIELD OF A PLANET **c13**
Edwin Wnuk *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 43-48 (For primary document see N92-24719 15-12)
(Grant NR-2-1239-91-01)
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An analytical theory including first and higher order perturbations due to arbitrary degree and order coefficients of gravity field of a planet is presented. The theory is based on a form of geopotential expansion modified by introduction generalized lumped coefficients. Perturbations are calculated in orbital elements as well as in the components of radius vector. Exemplary perturbed orbits are calculated for some Earth artificial satellites using GEM-T2 and RAPP81 Earth's gravity models and for imaginary artificial Mars satellites using a Mars' gravity model. ESA

N92-24727# Valladolid Univ. (Spain). Departamento de Matematica Aplicada a la Ingenieria.
REDUCING THE ERROR GROWTH IN THE NUMERICAL PROPAGATION OF SATELLITE ORBITS **c13**
Jose M. Ferrandiz, Jesus Vigo, and P. Martin *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 49-54 (For primary document see N92-24719 15-12)
(Grant CICYT-ESP88-541)
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An algorithm especially designed for the long term numerical integration of perturbed oscillators, in one or several frequencies, is presented. The method is applied to the numerical propagation of satellite orbits, using focal variables, and the results concerning highly eccentric or nearly circular cases are reported. The method performs particularly well for high eccentricity. For e = 0.99 and J2 + J3 perturbations it allows the last perigee after 1000 revolutions with an error less than 1 cm, with only 80 derivative evaluations per revolution. In general the approach provides about a hundred times more accuracy than Bettis methods over one thousand revolutions. ESA

N92-24728# Zaragoza Univ. (Spain). Grupo de Mecanica Espacial.
RELEGATION OF THE PROPER ROTATION IN ATTITUDE DYNAMICS OF A SPACECRAFT **c18**
A. Elipe, M. Arribas, and J. Palacian *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 55-59 (For primary document see N92-24719 15-12)
(Grants CICYT-PB90-0921; CICYT-ESP91-0919)
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The problem of the coupled motion orbital rotational of a satellite with three different axes of symmetry in fast rotation is considered. The principal term (of order 0) is made of two parts: the part H(K) describing the motion of the center of mass of the satellite about the planet is expressed in terms of the Whittaker variables, and the part H(E) accounting for the rotation of the satellite about its center of mass in the absence of external forces which is expressed in terms of the Serret-Andoyer variables. The difficulty of building a generating function for a Lie transformation that removes the angle g in the perturbation is resolved by applying the 'relegation of the node' technique. The development is performed symbolically. At each order, the generating function is built recursively: trigonometric terms appeared with powers of the parallax factor of increasing exponents. The iteration is stopped when it reaches powers that are too small to affect significantly the normalized system. ESA

N92-24729# Ceskoslovenska Akademie Ved, Ondrejov. Inst. of Astronomy.
ORBITAL PERTURBATIONS DUE TO THE ALBEDO EFFECT **c13**
L. Sehnal, D. Vokrouhlicky, and Jan Straka (GKSS-Forschungszentrum Geesthacht, Germany, F.R.) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 61-64 (For primary document see N92-24719 15-12)
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Some aspects of the perturbative influence of the radiation reflected from the Earth surface in the motion of an artificial satellite are discussed. The model taken into account uses the development of the albedo distribution into a series of spherical harmonics. The dependence of the albedo on the inverse square root of the solar zenith angle is taken into account. Joint consideration of the diffusive and specular reflection results in a narrow peak of the radiative pressure near the border of the Earth shadow. The role of scattering of the radiation in the Earth atmosphere is estimated by using a simple model of cloudiness distribution. The radial component of the disturbing acceleration is the most conspicous one; the effect due to accentuated specular reflection at the Earth's shadow borders is perceptible on the 10(exp -9) m/s(exp 2) level for ERS-1 satellite. ESA

N92-24730# Zaragoza Univ. (Spain). Grupo de Mecanica Espacial.
AN EFFICIENT FORMULATION FOR NUMERICAL ORBIT COMPUTATION **c13**
A. Abad, M. Palacios, and M. Sein-Echaluce *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 65-70 (For primary document see N92-24719 15-12)
(Grants CICYT-PB90-0921; CICYT-ESP91-0919)
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The equations of the motion of a perturbed keplerian orbit are formulated in a non standard way which represents plainly the dynamical behavior of the solution, and avoids singularities in inclination. Quaternions are used for describing rotations between the different frames with a consequent increase of speed and precision. Several tests are performed, and about two significant digits are gained with this formulation. ESA

N92-24731# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
SOME RESULTS OF THE ERS-1 RADAR ALTIMETER CALIBRATION **c32**
Karel F. Wakker, R. Scharroo, and B. A. C. Ambrosius *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 73-79 (For primary document see N92-24719 15-12)
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The ERS-1 altimeter is capable of measuring the height of the satellite above the sea surface, ice or flat land areas with a precision of a few centimeters. However, the measurements may be corrupted by a constant bias. For the in orbit calibration of the altimeter a procedure was developed that is based on the selection of a three day repeat orbit, in which the satellite overflies an oceanographic platform in the Adriatic Sea every three days. Laser tracking data acquired by a network of European systems are used to compute the altitude of the satellite over this platform. The combination of this computed altitude with the altimeter height measurements and all kinds of local sea and atmospheric measurements taken at the platform provides an estimate of the altimeter bias. Some aspects of the calibration concept are addressed and intermediate results of the calibration analysis are presented. ESA

N92-24732# Munich FAF Univ., Neubiberg (Germany, F.R.). Inst. of Astronomical and Physical Geodesy.
CALIBRATING THE ERS-1 RADAR ALTIMETER BY USING GPS IN BUOYS **c32**
Guenter W. Hein, Herbert Landau, and Helmut Blomenhofer *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 81-90 Sponsored by Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H. (For primary document see N92-24719 15-12)

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During the commissioning phase of ERS-1 three free drifting buoys separated by approximately 4 km were placed on the North Sea area directly under the ground track of the ERS-1 altimeter. These buoys were equipped with Global Positioning System (GPS) receiver hardware and tilt sensors. In combination with a fourth GPS receiver on the shore it is possible to determine the instantaneous sea surface with an accuracy of better than 5 cm from these data. This accuracy could be verified even for fast moving sensors on aircrafts like airborne photogrammetric cameras at the time of exposure. Sophisticated kinematic software was developed resolving cycle slips and carrier phase ambiguities during motion. In order to determine the instantaneous sea surface, the GPS receiver is placed in a free drifting buoy with the antenna on top. A radio link is used to transfer data to the reference station and to determine the buoy location and height in real time. First results of the data analysis are presented. Differential GPS seems to be also the appropriate tool for the calibration of the radar altimeter of the French/U.S. TOPEX/Poseidon mission. ESA

N92-24733# Centre National d'Etudes Spatiales, Toulouse (France).

PRECISE ORBIT DETERMINATION WITH THE DORIS/SPOT2 SYSTEM: FIRST RESULTS **c13**

F. Nouel, J. P. Berthias, P. Broca, A. Comps, M. Deleuze, A. Guitart, C. Jayles, P. Laudet, C. Pierret, and A. Piuzzi et al *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 91-95 (For primary document see N92-24719 15-12)

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One of the main challenges of the French/U.S. oceanographic mission, TOPEX/Poseidon, is the need to determine the position of the spacecraft with an accuracy of 10 cm in the radial direction after 10 days. In order to reach this level of accuracy, a tracking system, Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS), was developed. This system is composed of a network of about 40 dual frequency beacons scattered all over the world and a receiver on board a spacecraft. The spaceborne processor integrates the Doppler shifts over 10 second intervals and downloads the results and the measurements time tags to the ground control center. An orbit determination software, ZOOM, was developed to generate precise orbits. This program has the capability to process the DORIS data type in addition to all other conventional measurements. As a proof of concept and feasibility test, the first DORIS receiver was placed on the SPOT 2 Earth observation satellite. The whole system (hardware and software) has worked successfully since Feb. 1990, enabling the routine computation of the orbit of SPOT 2 for more than one year. An overview of the orbit production process including the operational set up and the dynamical and measurement models is presented. The orbit quality assessment procedures are described and the ability to ensure the consistency of the system in spite of the large number of independent oscillators, is demonstrated. ESA

N92-24734# Politecnico di Torino (Italy). Dipartimento di Automatica e Informatica.

THE ON-GROUND ATTITUDE RECONSTITUTION OF THE HIPPARCOS SATELLITE **c18**

E. Canuto and Francesco Donati *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 97-103 Prepared in cooperation with Centro di Studi sui Sistemi, Turin, Italy (For primary document see N92-24719 15-12)

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An accurate, on-ground reconstitution of the satellite three-axis attitude from downlinked data (gyro readings and star mapper photo counts) is an essential factor in the final accuracy of the Hipparcos Astrometric Catalogue. The reconstitution method was developed by the FAST Consortium (one of two Consortia charged with Hipparcos Data Reduction by ESA) and is currently in use to process Hipparcos data. One of its main features is that only star mapper measures are used; gyro readings are neglected. The main reconstitution models and algorithms are outlined and an accuracy assessment of the estimated attitude is presented. Assessment shows that attitude root mean square (RMS) errors are already around the mission target of 0.5 microrad, a value that is expected to be met when attitude reconstitution is iterated upon the first Hipparcos Catalogue. ESA

N92-24735# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).

CURRENT ACTIVITIES AND FUTURE PLANS FOR GPS APPLICATIONS **c04**

John M. Dow *In its* Spacecraft Flight Dynamics Dec. 1991 p 105-111 (For primary document see N92-24719 15-12)

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In order to prepare for support of future spacecraft requiring use of the Global Positioning System (GPS), ESA is upgrading the GPS receivers installed in several stations of its ground network, and in parallel is developing the software tools needed for high precision processing of GPS data. Preparations are underway for participation in an International GPS Geodynamics Service (IGS). A preoperational test of the IGS concept will take place over a period of three months in the Summer of 1992. The aims of this participation in relation to overall support for near Earth missions are outlined. Ongoing work in reduction of the data of a recent global GPS campaign is discussed, and a status report is given in a contract for accurate surveys of the stations of the ESA network using GPS. ESA

N92-24736# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.). Orbit Attitude Div.

COVARIANCE TRANSFORMATIONS AND GLOBAL ERRORS FOR ORBIT AND ATTITUDE **c13**

L. Fraiture *In its* Spacecraft Flight Dynamics Dec. 1991 p 113-124 (For primary document see N92-24719 15-12)

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The general principle of covariance transformations is discussed and applied to attitude and orbit related parameterizations. The global errors which can be constructed to allow a comprehensive assessment of accuracy performance are discussed. The reliability of covariance transformations in first order approximations is investigated, and in the context of orbit and attitude reliability is shown on the basis of test cases. ESA

N92-24737# Academy of Sciences (USSR), Moscow. Inst. of Applied Mathematics.

NAVIGATION FOR A RADAR MAPPING SATELLITE OF VENUS **c91**

E. L. Akim, V. A. Stepanyants, and Z. P. Vlasova *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 127-132 (For primary document see N92-24719 15-12)

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In order to obtain high quality images of Venus and to construct a relief map of its surface by using side looking radar and radio-altimeter observations from a spacecraft operating in a near Venus orbit, the trajectory of the spacecraft relative to the planet needs to be known with high precision. For solving this problem, a ground based and spaceborne measurement data processing system was developed. The system was used successfully for the radar mapping of Venus from the Soviet Venera 15 and 16 spacecraft. It is hoped that the methods developed and the experience gained may also be useful in the Magellan Project. ESA

N92-24738*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

COBE NAVIGATION WITH ONE-WAY RETURN-LINK DOPPLER IN THE POST-HELIUM-VENTING PHASE **c13**

Joan Dunham, M. Nemesure, M. V. Samii, M. Maher (Bendix Field Engineering Corp., Lanham, MD.), Jerome Teles, and J. Jackson

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(Contract NAS5-31500)
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The results of a navigation experiment with one way return link Doppler tracking measurements for operational orbit determination of the Cosmic Background Explorer (COBE) spacecraft are presented. The frequency of the tracking signal for the one way measurements was stabilized with an Ultrastable Oscillator (USO), and the signal was relayed by the Tracking and Data Relay Satellite System (TDRSS). The study achieved three objectives: space qualification of TDRSS noncoherent one way return link Doppler tracking; determination of flight performance of the USO coupled to the second generation TDRSS compatible user transponder; and verification of algorithms for navigation using actual one way tracking data. Orbit determination and the inflight USO performance evaluation results are presented. ESA

N92-24739*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ORBIT DETERMINATION SUPPORT FOR HITEN'S AEROBRAKING IN THE EARTH'S ATMOSPHERE **c13**
L. Efron, J. Ellis, P. R. Menon, and B. Tucker *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 141-147 Sponsored by NASA, Washington (For primary document see N92-24719 15-12)
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Two passes of the ISAS (Japan's Institute of Space and Astronautical Science) Hiten spacecraft through the Earth's atmosphere, at perigee altitudes of 125 km and 120 km, during Mar. 1991 marked the first aerobraking technology demonstrations for an object in cis-lunar orbit traveling at near Earth escape velocity. Prediction and control of perigee altitude to better than 1 km was desired to assure spacecraft survival. Covariance analysis provided confidence that prediction accuracy better than 200 m for support of final trim maneuver design was achievable with NASA DSN (Deep Space Network) tracking support. ISAS used orbit determination results in their decisions to cancel final trim maneuvers. Post flight reconstructions, marking the first combined use of DSN and ISAS tracking data, yielded perigee altitude solutions which agree with the near real time mission operations support predictions to better than 50 m. ESA

N92-24740# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TESTING, ANALYSIS, AND ASSESSMENT OF OD SYSTEM SOFTWARE FOR THE FIRST BRAZILIAN SATELLITE **c13**
Helio Koiti Kuga and Rama Rao Kondapallo *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 149-153 (For primary document see N92-24719 15-12)
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The characteristics of OD (Orbit Determination) system software are defined and dictated by the orbital configuration of the satellite in question. The testing, analyzing, and assessing of the software developed for the first Brazilian satellites are addressed. The estimation method used is that of weighted least squares differential correction. To make the qualification, testing, and analysis more reliable, various satellites from different organizations were considered and in each test case, different combinations of perturbation models were employed. The results for all the satellites agreed very well with those obtained by owner organizations. ESA

N92-24741*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ULYSSES NAVIGATION
H. J. Gordon, T. P. McElrath, and P. R. Menon *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 155-161 Sponsored by NASA, Washington (For primary document see N92-24719 15-12)
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Ulysses, a cooperative NASA and ESA project, measures charged and neutral particles, magnetic fields, and electromagnetic wave emissions from the Sun's polar regions and the out of elliptic heliospheric environment. ESA supplied the spacecraft and one half of the instruments, and is in control of the spacecraft and its attitude. NASA supplied the power supply, one half of the instruments, the launch vehicle, and tracks the spacecraft and performs the navigation. Orbit determination results mapped to the time of Jupiter's arrival show improved accuracy and consistency over the course of the mission to date. Solar radiation pressure model uncertainties are major contributors to orbit determination errors, but are being estimated more accurately as data are accumulated. ESA

N92-24742*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
EVALUATION OF TDRSS-USER ORBIT DETERMINATION ACCURACY USING BATCH LEAST-SQUARES AND SEQUENTIAL METHODS
D. H. Oza, T. L. Jones, M. Hodjatzadeh, M. V. Samii (Computer Sciences Corp., Lanham, MD.), C. E. Doll, R. C. Hart, and G. D. Mistretta *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 163-169 (For primary document see N92-24719 15-12)
(Contract NAS5-31500)
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The development of the Real-Time Orbit Determination/Enhanced (RTOD/E) system as a prototype system for sequential orbit determination on a Disk Operating System (DOS) based Personal Computer (PC) is addressed. The results of a study to compare the orbit determination accuracy of a Tracking and Data Relay Satellite System (TDRSS) user spacecraft obtained using RTOD/E with the accuracy of an established batch least squares system, the Goddard Trajectory Determination System (GTDS), is addressed. Independent assessments were made to examine the consistencies of results obtained by the batch and sequential methods. Comparisons were made between the forward filtered RTOD/E orbit solutions and definitive GTDS orbit solutions for the Earth Radiation Budget Satellite (ERBS); the maximum solution differences were less than 25 m after the filter had reached steady state. ESA

N92-24743# Centre National d'Etudes Spatiales, Toulouse (France).
SURVEY ON SPOT-SYSTEM ORBIT-KEEPING EXPLOITATION (1986-1990) **c13**
Pascal Micheau *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 171-176 (For primary document see N92-24719 15-12)
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The Earth observation SPOT system fulfills a mission which implies following an operational orbit (requirements on ground track repeatability, local Sun time, and altitude). The keeping of such, an orbit is addressed. Its principles and a description of its performance during the operational life of SPOT 1, and then of the SPOT1/SPOT2 pair (from Feb. 1990), are recalled. The theoretical relationships between the evolutions of mission and orbital parameters are described. SPOT orbit keeping is discussed, with a summary of its constraints and of the joined strategy; the actual evolutions of the parameters are analyzed, in correlation with Earth environment data (e.g., influence of solar flux) and ground support operational constraints. Orbit keeping of the SPOT1/SPOT2 pair begins with control of the orbital rendezvous of the latter. Principles of this phase are outlined and an analysis of the angular phase shift of the two satellites on their mission orbit, is detailed. As a synthesis of this study, the sensitivity of LEO (Low Earth Orbit) orbit keeping to the requirements (numerical values of windows in ground track repeatability, local Sun time, and altitude), to the physical evolution of orbital parameters (mainly due to terrestrial environment), and to the constraints of ground operations, is highlighted. ESA

N92-24744# Centre National d'Etudes Spatiales, Toulouse (France).
ON-BOARD LOW EARTH-ORBIT DETERMINATION **c13**
C. Jayles and H. Renault (Aerospatiale, Cannes, France) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 177-179 (For primary document see N92-24719 15-12)
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A project, aimed at developing the prototype of onboard orbit determination software, using DORIS (Doppler Orbitography and Radiopositioning Integrated by Satellite) measurements, is reported. The Navigator uses real DORIS measurements, coming from the receiver flying on SPOT2; it is able to perform real time orbit determination with a precision better than 100 m with reference to the precise orbit computation made with the ZOOM software. These results are good arguments to consider an integration of the navigation function, in the DORIS receiver. ESA

N92-24745*# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.). Mission Analysis Section.
REVIEW OF ESOC RE-ENTRY PREDICTION RESULTS OF SALYUT-7/KOSMOS-1686
H. Klinkrad *In its* Spacecraft Flight Dynamics Dec. 1991 p 181-200 Sponsored by NASA. Johnson Space Center; NASA. Goddard Space Flight Center; Academy of Sciences; Ministry of Defence; USSR Mission Control; Research Establishment for Applied Science; RAE; CNR; and CNES/CST (For primary document see N92-24719 15-12)
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An overview of activities at ESA/ESOC during the followup of the Salyut-7/Kosmos-1686 decay, and of related cooperations with space agencies, research institutes, and national bodies within the ESA Member States, within the U.S. and within the USSR, is presented. A postflight analysis indicated areas for improvement in the forecast procedures, especially during the last day of the orbital lifetime. Corresponding revised decay predictions are presented for Salyut-7/Kosmos-1686, and the improved procedures are verified by an analysis of the reentries of Kosmos-1402A and Kosmos-1402C. ESA

N92-24746*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GALILEO ATTITUDE DETERMINATION: EXPERIENCES WITH A ROTATING STAR SCANNER **c13**
L. Merken and G. Singh *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 203-211 (For primary document see N92-24719 15-12)
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The Galileo experience with a rotating star scanner is discussed in terms of problems encountered in flight, solutions implemented, and lessons learned. An overview of the Galileo project and the attitude and articulation control subsystem is given and the star scanner hardware and relevant software algorithms are detailed. The star scanner is the sole source of inertial attitude reference for this spacecraft. Problem symptoms observed in flight are discussed in terms of effects on spacecraft performance and safety. Sources of thse problems include contributions from flight software idiosyncrasies and inadequate validation of the ground procedures used to identify target stars for use by the autonomous on-board star identification algorithm. Problem fixes (some already implemented and some only proposed) are discussed. A general conclusion is drawn regarding the inherent difficulty of performing simulation tests to validate algorithms which are highly sensitive to external inputs of statistically 'rare' events. ESA

N92-24747# Science Systems Ltd., Bristol (England).
HIPPARCOS: ATTITUDE DETERMINATION WITH TWO GYROS AND A STAR MAPPER **c13**
J. H. C. Auburn, A. J. Batten, and A. J. C. McDonald (Logica Ltd., London, England) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 213-220 (For primary document see N92-24719 15-12)
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Given the risk of the failure of both spin axis oriented gyros on Hipparcos, a backup system was devised to allow onboard Real Time Attitude Determination (RTAD) using only two gyros, augmented by star mapper measurements. This involved major changes to both the onboard and onground systems. The relationships between the two systems is summarized with emphasis on the onground system, which must reacquire the spacecraft attitude after each perigee passage. The principle of filtering the star mapper data to obtain transit times and spin rates is described. The effects of the increased inaccuracies on the following attitude prediction are assessed. The method whereby the times and durations of the timed thruster firings around perigee are determined is described. Details of the operational scenario for reacquiring the attitude in the shortest possible time after perigee, thereby safeguarding the scientific data return from an otherwise terminated mission, are given. ESA

N92-24748# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.). Orbit Attitude Div.
OLYMPUS RECOVERY: ATTITUDE ASPECTS **c18**
P. deBroeck *In its* Spacecraft Flight Dynamics Dec. 1991 p 221-229 (For primary document see N92-24719 15-12)
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The Olympus spacecraft was recovered from a major anomaly that occurred at the end of May 1991. As a result of this anomaly, the spacecraft went into a totally uncontrolled mode, drifting away from its geostationary location (19 deg west) with a rate of about 56 degrees east per day, due to unwanted thruster firings which took place during the anomaly, and spinning about its X axis with a period of about 90 seconds. Since the solar arrays were no longer orientated to the Sun, the power dropped rapidly, emptying the batteries and freezing the spacecraft, including its propellant. Although initially very little hope was given for recovery of the spacecraft, nevertheless a successful recovery could be achieved during a concentrated activity. The attitude dynamics aspects of the Olympus spacecraft during the recovery activities are described. ESA

N92-24749*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
HUBBLE SPACE TELESCOPE POINTING CONTROL SYSTEM: DESIGNED FOR PERFORMANCE AND MISSION OPERATIONS
A. Bradley (Allied-Signal Aerospace Co., Annapolis, MD.) and J. Ryan *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 231-238 (For primary document see N92-24719 15-12)
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The Hubble Space Telescope was designed to be an orbiting astronomical observatory which could be operated in the same manner as ground based observatories. The design drivers for the pointing control system's hardware and software were the requirements of an absolute pointing accuracy of 4.8E-8 radians and pointing stability (jitter) of 3.4E-8 radians. Of comparable importance was the objective of providing a flexible command methodology and structure to enable seven day operational planning employing stored program command and real time command capability. The pointing control system hardware, software, safemode control schemes, ground system monitoring capability, and in-orbit results are reviewed. ESA

N92-24750*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE IN-FLIGHT CALIBRATION OF THE HUBBLE SPACE TELESCOPE FINE GUIDANCE SENSORS **c89**
G. L. Welter, L. Abramowicz-Reed, Aloke K. Guha, L. Hallock, and E. Kimmer (Allied-Signal Corp., Kansas City, MO.) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 239-244 (For primary

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The Hubble Space Telescope (HST) fine guidance sensors are unique in the precision and performance levels being attempted; spacecraft control and astrometric research at the near milliarcsecond level are the ultimate goals. The inflight calibration of the sensors is presented, describing both the algorithms being used as well as the results achieved to date. The calibration items of principal interest are optical distortion, sensor magnification, and relative alignments. Calibration accuracies at the 20 milliarcsecond level have been achieved for specific data sets for optical distortion parameters. Unexpected variations occurring from Dec. 1990 - May 1991 in the magnification and alignment parameters are currently under investigation. Plans are being developed for new data acquisitions and reductions that should substantially improve HST pointing performance. ESA

N92-24751# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.). Orbit Attitude Div.

ULYSSES PRINCIPAL AXIS TILT DETERMINATION AND C-LOADING **c18**

G. Gienger *In its* Spacecraft Flight Dynamics Dec. 1991 p 245-250 (For primary document see N92-24719 15-12)
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Ulysses was launched on 6 Oct. 1990 to explore the polar regions of the Sun. The experiments aboard the spin stabilized spacecraft require an accurately phased spin reference pulse. The necessary procedure, from compilation of Sun sensor mounting data, determination of principal axis tilts from meridian slit Sun crossings, up to calculation and verification of phase correction C to the onboard spin reference pulse are presented. ESA

N92-24752# Science Systems Ltd., Bristol (England).

ATTITUDE ASPECTS OF THE GIOTTO EXTENDED MISSION **c18**

M. J. H. Walker *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 251-257 (For primary document see N92-24719 15-12)
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Giotto, launched in 1985 on a mission to comet Halley, survived the encounter damaged, but in operable condition. The damage received and its implications on operations are described. The chosen extended mission after the Halley flyby was to perform an encounter with comet Grigg-Skellerup on 10 Jul. 1992. Hibernation periods and an Earth flyby were involved. These activities and future operations are described. ESA

N92-24753# Science Systems Ltd., Bristol (England).

ISO GROUND ATTITUDE DETERMINATION DURING OPERATIONS **c13**

A. J. Batten *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 259-264 (For primary document see N92-24719 15-12)
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The attitude determination algorithm developed for the ISO (Infrared Space Observatory) spacecraft ground control, to be used for attitude initialization during Launch and Early Operations Phase (LEOP), and for any later attitude updates required during the mission, is described. The attitude determination task contains a star pattern recognition algorithm, using a star map generated by the spacecraft Star Tracker, and requires no a priori attitude estimates. Derivation of the algorithms for the attitude determination task is given. The practical implementation of the task within the overall ground control segment, where a workstation running Open Windows is employed, is described. ESA

N92-24754# Science Systems Ltd., Bristol (England).

THREE-AXIS STABILISATION IN LEOP: AUTONOMY OR GROUND CONTROL? **c18**

J. H. C. Auburn *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 267-273 (For primary document see N92-24719 15-12)
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LEOP (Launch and Early Operations Phase) support for two three axis stabilized spacecraft which use very different attitude control systems is addressed. Olympus was launched in Jul. 1989 and Italsat in Jan. 1991. The Olympus and Italsat onboard attitude and orbit control systems are outlined with emphasis on the transfer orbit phase. The ground control systems for both spacecraft are described with a review of the actual operational experience. The different role of the ground control systems are detailed, and the advantages and disadvantages of both systems analyzed. Future trends in the design of the ground control systems are discussed. ESA

N92-24755# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Space Dynamics Section.

ESTIMATION OF ATTITUDE THRUSTER ACTIVITY OF SPACECRAFT ON SUN ACQUISITION MODE **c18**

O. Montenbruck and E. Gill *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 275-278 (For primary document see N92-24719 15-12)
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In the course of positioning the phase of Eutelsat 2 F1 and F2, notable orbit perturbations were observed when the satellites were in Sun Acquisition Mode (SAM). Analysis of the tracking data residuals indicated a type of perturbation similar to the effect of the solar radiation pressure. Investigating various possible explanations it became clear that the effect could be attributed to the attitude thruster activity in SAM. In this mode, thrusters facing the Sun are used to control the pitch axis, while thrusters in the opposite side are used for yaw axis control. Since the acceleration due to each thruster has a considerable component along the rotation axis, a continuous attitude control results in an effect similar to the solar radiation pressure. A detailed analysis of the thruster on time telemetry together with information on expected thruster performance was used to model the observed perturbations for different types of orbits. ESA

N92-24756# Tsukuba Space Center, Ibaragi (Japan).

OPERATIONAL STRATEGIES FOR LIQUID APOGEE PROPULSION SYSTEM **c20**

M. Hirota, Mikio Sawabe, Hiruko Aoki, and T. Shimizu (Fujitsu Ltd., Tokyo, Japan) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 279-284 (For primary document see N92-24719 15-12)
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The plan to launch an Engineering Test Satellite, the ETS-6, in 1993 is reported. The operation involves a three stage apogee maneuver that will move the ETS-6 from an elliptical transfer orbit to a near synchronous orbit. The move is powered by liquid fuel. The apogee maneuver is split into three stages, in order to compensate for magnitude and direction of thurst error. An important aspect of the operation is that apogee engine firing execution commands will be sent from the station. The final orbit achieved by the steps should put the ETS-6 into the optical acquisition range defined by a combination of deviations in satellite longitude: apogee height and orbital plane. Injection strategies for nominal and backup cases, plus the optimal thrust direction and burn times calculated considering time restrictions and mission constraints, are discussed. ESA

N92-24757# Centre National d'Etudes Spatiales, Toulouse (France).
INMARSAT-2 F1 AND F2 LAUNCH AND EARLY OPERATION PHASES ASSESSMENT OF THE IMPACT OF CONTINGENCY CASES ON ATTITUDE DETERMINATION USING IN-FLIGHT DATA **c18**
Gilles Tavernier *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 285-290 (For primary document see N92-24719 15-12)
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The Inmarsat 2 spacecrafts are spin stabilized during the transfer phase. Attitude data are provided by an Earth Sun Sensor (ESS). Thus, it is possible to compute Sun and Earth aspect angle and then to determine the satellite attitude. Biliquid spinned satellites such as Inmarsat 2, Telecom 2, and Hispasat are characterized by large dynamic wobble angles partially deterministic (depending on the tank fill fraction). Inmarsat 2 F1 was launched in Oct. 1990 and F2 in Mar. 1991. In both cases, the ESS functioned properly for attitude determination. The attitude data collected during the two LEOP's (Launch and Early Operation Phases) was used to simulate attitude sensor disfunctioning and to assess their impact on attitude determination. These data were also used to validate a new attitude software. ESA

N92-24758# Science Systems Ltd., Bristol (England).
ITALSAT MULTIPLE APOGEE ENGINE FIRINGS **c18**
D. Hocken *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 291-295 (For primary document see N92-24719 15-12)
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The Italsat apogee engine firing strategy is unusual in that the spacecraft drifts west in the planned near synchronous orbit. The combination of constraints producing this solution is examined and the operational aspects of implementing it are considered. The results of the Italsat apogee engine firings are described and an estimate of the spacecraft lifetime is given. Possible improvements of the Italsat strategy for Artemis are noted. ESA

N92-24759# Grupo de Mecanica del Vuelo S.A., Madrid (Spain).
AUTOMATION CONCEPTS FOR GEOSYNCHRONOUS ORBIT CONTROL: A PEPSOC BASED AUTOMATED, DECISION MAKING SUPPORT TOOL **c18**
J. Potti *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 297-303 (For primary document see N92-24719 15-12)
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Several software packages currently exist for orbital control of geostationary satellites, all of them requiring the operator to perform several tasks manually. The basic philosophy of the operations with those packages is that only the calculations are performed by the orbit control programs, while programs handling, decision making, scheduling of operations, and others are operator responsibility. Two hardware/software products are presented which represent different approaches to automate the orbit control of geostationary satellites based on PEPSOC (Portable ESOC Package for Synchronous Orbit Control) in a user friendly environment: a PC (Personal Computer) based implementation and extension of PEPSOC by means of traditional software techniques, and a state of the art work station based implementation by using an expert system shell. ESA

N92-24760# Academy of Sciences (USSR), Moscow. Inst. of Applied Mathematics.
DYNAMICS OF AEROSPACE SHUTTLES **c16**
Y. G. Sikharulidze, A. V. Burov, and V. S. Ladygin *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 307-310 (For primary document see N92-24719 15-12)
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The controlled motion of an aerospace shuttle descending through the atmosphere is analyzed by using a mathematical modeling. The shuttle model includes a bank of aerodynamic characteristics, geometry, parameters of the reaction control system and aerodynamic control surfaces, algorithms of the control system, etc. The model of perturbed atmosphere describes the environment. In numerical integration of the motion equations certain difficulties arise because of discontinuities in the right hand side due to the switch on of orientation engines as well as small step of integration (0.03 to 0.05 s) and long time of descent through the atmosphere (1800 to 2000 s). Methods of increasing the accuracy of calculations by improving the models and computational techniques used are discussed. ESA

N92-24761# Academia Sinica, Beijing (China). Center for Space Science and Applied Research.
SIMULATION RESULTS OF COUPLING DYNAMICS FOR SPACECRAFT WITH PANELS OF LARGE SIZE **c18**
Huai-Bao Gao *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 311-316 (For primary document see N92-24719 15-12)
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A study which assumes that the spacecraft is a collection of the central body and two panels of large size which can rotate about one axis with respect to the central body is presented. The dynamical interaction between the orbit and attitude are discussed. The physical model of the spacecraft is described. Equations governing coupling motion of the orbit attitude are derived. Some numerical simulation results of coupling dynamics are presented. ESA

N92-24762# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
MAGNETICALLY STABILIZED SATELLITE ATTITUDE MOTION AND DIFFERENTIAL EQUATIONS WITH SLOWLY CHANGING COEFFICIENTS **c18**
M. L. Pivovarov *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 317-322 (For primary document see N92-24719 15-12)
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Plane attitude motion of a spacecraft with a constant magnet and a passive damper is considered. Two types of damping are studied: the damping by using magnetic hysteresis loop and the full filled annular damper for arbitrary Reynolds. Small three dimensional oscillations of an axisymmetrical spacecraft with a constant magnet along the symmetry axis are studied. Magion-2 subsatellite attitude determination results are discussed. This is the first magnetically stabilized spacecraft with a viscous annular damper. ESA

N92-24763# Academy of Sciences (USSR), Moscow. Inst. of Applied Mathematics.
GRAVITY ORIENTATION OF LARGE SPACE STATIONS **c18**
V. A. Sarychev and V. V. Sazonov *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 323-330 (For primary document see N92-24719 15-12)
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Attitude motion of Earth artificial satellites is studied for the single axis gravity gradient stabilization. The assumptions about the satellite inertia tensor, which are valid for large orbital stations like Salyut-6 and 7, enable the introduction of small parameters into the rotational motion equations and the contruction of three types of two dimensional integral manifolds of these equations, describing nominal motions of the satellite for the above stabilization mode. Main emphasis is put on the case when such manifolds consist of periodic solutions. ESA

N92-24764*# Computer Sciences Corp., Lanham, MD.
DYNAMICS MODELING FOR ERBS ATTITUDE PROPAGATION **c18**
E. Harvie and D. Chu *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 331-337 (For primary document see N92-24719 15-12)

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The development and evaluation of a model of the Earth Radiation Budget Satellite (ERBS) attitude dynamics for use in attitude determination is described. Attitude rates for the three axis stabilized spacecraft are derived analytically from Euler's equation using modeled disturbance torques and telemetered flight data from control system actuators for computation of the control torques. The modeled rates are used for attitude propagation in a batch least squares attitude estimation algorithm originally designed to use onboard gyro measurements of attitude motion. The capabilities for near fine attitude determination without gyros is important for operational attitude ground support of the aging ERBS spacecraft as two out of three gyro axes have failed. The accuracy of this method of dynamic propagation is strongly dependent on the quality and availability of control system telemetry data. Detailed disturbance torque models are also necessary to accurately model attitude rates. Even with the relatively coarse ERBS control system telemetry, accuracy to within 0.2 deg of gyro propagated reference attitudes is achieved. ESA

N92-24765# Chinese Academy of Space Technology, Beijing. Inst. of Spacecraft System Engineering.
ON DEVELOPMENT OF LARGE SPACECRAFT DYNAMICS IN CHINA **c18**
Guangji Qu, Dengyun Yu, Ruqing Xi, and Zhonggui Chen *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 339-345 (For primary document see N92-24719 15-12)
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The development and applications on dynamics of large complex spacecraft with large flexible appendages and liquid filled containers in China is introduced. Besause of structure flexibility, liquid slosh, multibody motion and lock impact, the dynamic characteristics of this kind of spacecraft are getting more and more complicated. The main results of dynamic models for all kinds of dynamic problems, main functions and engineering application examples of corresponding analysis programs are summarized. ESA

N92-24766# Academy of Sciences (USSR), Moscow. Inst. of Applied Mathematics.
AERODYNAMIC STABILIZATION SYSTEM OF SMALL SCIENTIFIC SATELLITE **c18**
M. Y. Ovchinnikov and V. I. Penkov (Moscow Inst. of Aviation Technology, USSR) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 347-353 (For primary document see N92-24719 15-12)
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The dynamics of a small scientific satellite intended for investigating the density of upper layers of the atmosphere is considered. The aerodynamic stabilization along the free air stream vector is provided by passive orientation system. The perturbed motions of the satellite are damped by hysteresis rods of soft magnetic material. The transient and steady state motions of the satellite are studied. The parameters and the number of rods to be manufactured of 79NiMo Permalloy are selected. ESA

N92-24767# Columbia Univ., New York, NY. Dept. of Mechanical Engineering.
NEW PROBLEMS IN SPACE FLIGHT OPERATIONS INTRODUCED BY SATELLITE MOUNTED ROBOTS **c18**
Richard W. Longman *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 357-362 (For primary document see N92-24719 15-12)
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A tutorial paper giving an overwiew of a set of new problems in mission operations introduced by having robots in space is presented. The difficulty of planning a history of robot joint angles to place the end effector in a desired position in space, when the satellite on which the robot is mounted moves in response to the robot maneuvers, is addressed. Problems of limiting the disturbances of the robot motion on the attitude of the spacecraft which may contain instruments requiring fine pointing accuracy, and on the microgravity environment of these spacecraft required by some experiments and processes in space, are considered. Problems related to the flexibility of the large lightweight robots used in space are addressed. It is shown that the robot vibrations induced by robot manipulation, will usually tend to tumble the spacecraft after the end of the robot maneuver. ESA

N92-24768# Padua Univ. (Italy). Dept. of Mechanical Engineering.
FUNCTIONAL OBJECTIVES OF DYNAMICS EXPERIMENTS IN THE TSS-1 MISSION **c18**
S. Bergamaschi and A. Catinaccio *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 363-368 (For primary document see N92-24719 15-12)
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Three of the scientific experiments to be carried out during the flight of TSS-1 (Tethered Satellite System) are dedicated to the study of its dynamics. The purposes of these experiments are quite similar and categorized in a list of 13 Dynamics Functional Objectives (DFOs), some of which require that active perturbations by the Orbiter or the satellite thrusters be applied to the system. In this scenario, a summary of the DFOs and some of the mathematical models used to analyze the vibratory regimes excited by thrusters firings are presented. Numerical results are given. ESA

N92-24769# Harbin Inst. of Tech. (China).
THE RESEARCH ON HIERARCHICAL CONTROL IN RENDEZVOUS AND DOCKING SYSTEM **c13**
A. D. Sheng, H. Z. Hu, and D. Wu *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 369-371 (For primary document see N92-24719 15-12)
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A state separation algorithm and a hierarchical control structure in rendezvous and docking system are discussed. The algorithm was used to obtain some formulations of relative moving parameters between the chase vehicle and the target vehicle in the system. A hierarchical control structure used in the system was expected to make the optimization and real time control easy. In order to improve the control effect, a hierarchical intelligent control design is given. ESA

N92-24770# Harbin Inst. of Tech. (China). Dept. of Applied Physics.
THE LASER SENSOR FOR RENDEZVOUS AND DOCKING OF SPACECRAFT **c36**
Yong-Jiang Dai, Yuan Zhao, Xi-Ping Cai, Tai-Ling Xin, and Chun-Fei Li *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 373-375 (For primary document see N92-24719 15-12)
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The principle of 'tilted effect' of the narrow interference filter is described and the laser sensor system which described how to measure attitude angles of the target spacecraft by the principle is presented. The result of laboratory experiment and error analysis are given. The experiment illustrated that it is practical to use the laser sensor system as the sensor for rendezvous and docking. ESA

N92-24771# Harbin Inst. of Tech. (China). Dept. of Applied Physics.
PHOTOELECTRIC SENSOR WITH PSD **c19**
Yuan Zhao, Yong-Jiang Dai, Xi-Ping Cai, and Chun-Fei Li *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 377-379 (For primary document see N92-24719 15-12)
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The photoelectric sensor with the Position Sensitive Detector (PSD) for Rendezvous and Docking (RVD) is described. The principle of measuring relative position and attitude of the target spacecraft by the sensor is given. Measuring the target by the principle, the experiment result is presented. The result indicates that it is practical using PSD as photoelectric sensor for RVD in close range. ESA

N92-24772# Padua Univ. (Italy). Dept. of Mechanical Engineering.

TETHER ASSISTED RE-ENTRY PRELIMINARY ANALYSIS FOR SEDS **c18**

S. Bergamaschi and F. Bonon *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 381-387 (For primary document see N92-24719 15-12)

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The proposal to conduct scientific activity in space by means of capsules tethered, as secondary payloads, to the second stage of the Delta launcher, is addressed. After tether cutoff, the capsules return to Earth, where they can be recovered. The mathematical models used to evaluate the initial conditions for deorbit and to study the reentry characteristics as functions of system parameters are presented. The results of numerical simulations are given. ESA

N92-24773# Tsukuba Space Center, Ibaragi (Japan). Tracking and Control Center.

SYNCHRONOUS OPERATION OF MOS-1 AND MOS-1b **c18**

T. Yoshikawa, M. Matsuura, K. Ueno, and M. Kashimoto *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 389-395 (For primary document see N92-24719 15-12)

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A method for realizing Sun synchronous and recurrent orbits is explained. Two orbits realized by this method have various properties effective for Earth observation. This method is based on considering the local Sun time of the descending node, the deviation of the ground track from a world reference system and the difference between two ground tracks. Simple functions are used in the analysis. The results obtained in applying this method to the synchronous operation of MOS-1 and MOS-1b (Marine Observation Satellites) are presented. ESA

N92-24774# Royal Aerospace Establishment, Farnborough (England). Space Dept.

LIMITATION OF SPACE DEBRIS IN GEOSTATIONARY TRANSFER ORBIT **c13**

R. Crowther *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 397-402 (For primary document see N92-24719 15-12)

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The hazard to mission operations posed by space debris in Geostationary Transfer Orbit (GTO) is considered. A number of debris mitigation strategies are considered. These include the harnessing of the luni-solar perturbation to the satellite orbit, atmospheric drag augmentation, and active propulsive deorbit. Results suggest that active deorbit using a dedicated propulsive unit offers the least performance penalty. ESA

N92-24775# Glavkosmos, Moscow (USSR). Mission Control Center.

SOVIET PROSPECTIVE SPACE PROJECTS AND THE MAIN BRANCHES OF THE FUNDAMENTAL AND APPLIED RESEARCH IN THE FIELD OF ASTRODYNAMICS AND SPACECRAFT NAVIGATION

V. N. Pochukaev and V. F. Tikhonov *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 405-412 (For primary document see N92-24719 15-12)

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A number of Soviet projects developed according to the indicated trends with realization dates up to the year 2000 are summarized. The following main parts are highlighted: scientific space projects; space navigation, geodesy and geodynamics; remote probing of the Earth; medical and biological research; space communication and television; space technology; manned complexes. ESA

N92-24776# Rome Univ. (Italy). Dipartimento di Ingegneria Aerospaziale.

A FEASIBILITY STUDY OF LOW-COST MISSIONS TO MERCURY

Marco M. Castronuovo *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 413-417 (For primary document see N92-24719 15-12)

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Only one space mission so far was aimed to Mercury: Mariner 10 in 1974. Being located deep inside the potential well of the Sun, Mercury is an expensive target for orbiters, but it is widely recognized that science at Mercury is of great relevance to our understanding of the solar system history. A preliminary study of new, low cost, missions to the planet is presented. Significant opportunities are found, for the first decade of the next century, to put a spacecraft into an orbit in the 2:3 resonance with the one of Mercury, thus allowing complete coverage of its surface for remote sensing investigations. Although the cruise phases are not optimized, it is shown that the possibility of such a mission is within the reach of ESA. ESA

N92-24777# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).

CLUSTER: FUEL OPTIMUM SPACECRAFT FORMATION CONTROL

J. Schoenmaekers *In its* Spacecraft Flight Dynamics Dec. 1991 p 419-425 (For primary document see N92-24719 15-12)

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The Cluster mission, an in situ investigation of the Earth's magnetosphere using four spacecraft simultaneously, is reported. Its objective is the accurate determination of three dimensional and time varying phenomena. The launch is planned for 1995 and the scientific operations are to last about two years. The spacecraft is to be placed in nearly identical highly eccentric polar orbits such that once per orbit, when crossing a region of scientific interest, they all are at the vertices of a tetrahedron with predefined separation distance. The region where the tetrahedron is formed and the relative separation is to be changed regularly during the mission. A method to calculate the trajectory maneuvers to establish, modify and maintain the tetrahedron flight configuration was developed. An alternative to this method is presented and the results of both methods are compared. ESA

N92-24778*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

RAPID DESIGN OF GRAVITY ASSIST TRAJECTORIES

J. Carrico, H. L. Hooper, L. Roszman (Computer Sciences Corp., Lanham, MD.), and C. Gramling *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 427-434 (For primary document see N92-24719 15-12)

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Several International Solar Terrestrial Physics (ISTP) missions require the design of complex gravity assisted trajectories in order to investigate the interaction of the solar wind with the Earth's magnetic field. These trajectories present a formidable trajectory design and optimization problem. The philosophy and methodology that enable an analyst to design and analyse such trajectories are discussed. The so called 'floating end point' targeting, which allows the inherently nonlinear multiple body problem to be solved with simple linear techniques, is described. The combination of floating end point targeting with analytic approximations with a Newton method targeter to achieve trajectory design goals quickly,

even for the very sensitive double lunar swingby trajectories used by the ISTP missions, is demonstrated. A multiconic orbit integration scheme allows fast and accurate orbit propagation. A prototype software tool, Swingby, built for trajectory design and launch window analysis, is described. ESA

N92-24779# Academy of Sciences (USSR), Moscow. Inst. of Space Research.

LUNAR SWINGBY AS A TOOL FOR HALO-ORBIT OPTIMIZATION IN RELICT-2 PROJECT

Natan Eismont, David Dunham, Shao-Cheng Jen, and Robert Farquhar (Johns Hopkins Univ., Laurel, MD.) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 435-439 (For primary document see N92-24719 15-12)

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The Relict-2 project for astrophysical experiments and for exploration of distance regions of the Earth's magnetotail is addressed. A Prognoz type spacecraft, which has a rather limited delta V capability, will be used. A lunar swingby is proposed in order to reach the desired orbit in the vicinity of the solar-terrestrial L2 libration point. Such a technique requires diminishing the amplitude of the halo orbit around L2 to the desired values and optimizing the orbit for planned experiments. The possibilities for realizing such orbits, taking into account technical restrictions imposed by the spacecraft motion control systems, are investigated. Achievable launch windows are determined for different amplitude halo orbits. Trajectories completed two, three, and four revolutions before the lunar swingby are analyzed. ESA

N92-24780# Academy of Sciences (USSR), Moscow. Inst. of Space Research.

OPTIMIZATION OF DOUBLE SWINGBYS

A. A. Suknanov *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 441-447 (For primary document see N92-24719 15-12)

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Interplanetary flights in which a spacecraft performs two swingbys about a planet are considered. The spacecraft trajectory before and after the double swingby is assumed to be given. The transfer between the swingbys is assumed to be free, and during each swingby active maneuvers are allowed. Requirements that the transfer should satisfy are determined. In cases when the transfer orbit is not unique, the way of its optimization (i.e., minimization of total delta V) is shown. ESA

N92-24781# Universidad Politecnica de Barcelona (Spain). Departament de Matematica Aplicada y Analisi.

A DYNAMICAL SYSTEMS APPROACH FOR THE ANALYSIS OF THE SOHO MISSION

Gerard Gomez, Angel Jorba, Josep Masdemont (Universidad Politecnica de Catalunya, Spain), and C. Simo *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 449-454 (For primary document see N92-24719 15-12)

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The results obtained in the analysis of several aspects of the SOHO mission are shown using techniques usual to the study of dynamic systems. The determination of the nominal orbit, the control strategy, and the transfer are considered. A first analysis is done in the framework of the RTBP (Restricted Three Body Problem), which gives a good insight of the strategies to be used in the real situation. For the computation of the nominal orbit, the use of ad hoc algebraic manipulators for the implementation of the Lindstedt-Poincare procedure allows the determination of an accurate solution in a very fast way. The knowledge of the behavior of the flow in the vicinity of the target orbit and the use of its invariant manifolds gives a new approach for the study of the stationkeeping and the transfer, which avoids the typical use of black box optimization strategies. ESA

N92-24782*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

MAGELLAN MISSION PLANNING AND ORBITAL OPERATIONS

James S. Carter and Anna M. Tavormina *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 457-464 Sponsored by NASA, Washington (For primary document see N92-24719 15-12)

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NASA's Magellan mission to understand the geological and geophysical processes that have shaped the planet Venus is reviewed. Through synthetic aperture radar, radiometric, altimetric, and gravity measurements, the scientific community hopes to improve its knowledge of the planet's topography and internal mass distribution. The spacecraft sequence software design, development, and test are described and the nominal operational flow of stored sequence design and generation are addressed. The ground processing of engineering telemetry and imaging data are described and the Magellan operational experience with nonroutine behavior of the spacecraft during the cruise and mapping portions of the prime mission is summarized. ESA

N92-24783# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

MISSION OPERATIONS OF THE SPACECRAFT HITEN **c66**

K. Uesugi, J. Kawaguchi, N. Ishii, M. Shuto, M. Kamimura, N. Muranaka, M. Uo, M. Ogasawara, A. Kimura, and S. Ishii (Nippon Electric Co. Ltd., Japan) et al *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 465-470 (For primary document see N92-24719 15-12)

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The launch on 24 Jan. 1990 of the space engineering satellite 'Hiten' is addressed. The Hiten primary mission goals are to verify technologies and techniques required for lunar and planetary missions in the near future. These include orbit control of Hiten utilizing multiple gravity assist lunar swingbys of the Moon, insertion of an orbiter into lunar orbit and aerobraking technology demonstrations in the Earth's atmosphere. A sophisticated mission design and its flexible operational schemes developed to accomplish these complicated missions are summarized. They are reported to have worked well through the Hiten's successful nine lunar swingby orbiting the lunar orbiter Hagoromo around the moon and the Hiten's two aerobrake demonstrations. ESA

N92-24784# Grupo de Mecanica del Vuelo S.A., Madrid (Spain).

ON THE 3-D CONFIGURATION OF THE CLUSTER MISSION **c66**

M. Bello-Mora and J. Rodriguez-Canabal (European Space Agency. European Space Operations Center, Darmstadt, Germany, F.R.) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 471-479 (For primary document see N92-24719 15-12)

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The selection of the operational orbit of Cluster and its relation with the new magnetic field models are reviewed and the optimization of a multiple maneuver control stategy to achieve the required three dimensional spacecraft configuration is analyzed. The optical solution is based on the transfer of each spacecraft from the departure orbit to the final orbit by performing two maneuvers per spacecraft. A recursive quadratic optimization method was used for the solution of the constrained nonlinear optimization. ESA

N92-24785# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.

NAVIGATION AND GUIDANCE TECHNIQUE FOR SFU'S RENDEZVOUS WITH SPACE SHUTTLE

Keiken Ninomiya, Toshimitsu Nishimura, Tetsuo Yamaguchi, Masao Sato, and Katsumi Tsukahara (Mitsubishi Electric Corp., Kanagawa, Japan) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 481-486 (For primary document see N92-24719 15-12)

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The Space Flyer Unit (SFU) is a retrievable and reusable platform which will be utilized for many kinds of scientific and engineering experiments in space. SFU was launched by a Japanese H2 launch vehicle and is to be retrieved by a U.S. Shuttle orbiter. The functions of the navigation, guidance and control subsystem (NGC) of SFU are autonomous navigation and guidance for rendezvous with STS using Global Positioning System (GPS), Inertial Measurment Unit (IMU), and NGC Computer (NGCC), as well as attitude control of an ordinary three axis controlled spacecraft. The design status of autonomous navigation and guidance logic for rendezvous with STS, and ground support functions are discussed. ESA

N92-24786# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
THE GIOTTO ENCOUNTER WITH COMET P/GRIGG-SKJELLERUP **c66**
T. A. Morley *In its* Spacecraft Flight Dynamics Dec. 1991 p 487-491 (For primary document see N92-24719 15-12)
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On 10 Jul. 1992, ESA's Giotto spacecraft is to encounter comet P/Grigg-Skjellerup. The deterministic encounter conditions are described, including Giotto's trajectory relative to the comet and the attitude geometry. Based upon an assumed schedule of comet astrometric observations in 1991/92, a covariance analysis is used to find the expected contribution to the final targeting errors due to the uncertainty in the comet's orbit. Under pessimistic assumptions, the comet's position in the target plane will be known with a 3 sigma accuracy of about 1800 km and the time of closest approach to little better then two minutes. Even under optimistic assumptions, these 3 sigma values will be about 800 km and 50 seconds. ESA

N92-24787# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
ERS-1 OPERATIONAL ORBIT DETERMINATION AND PREDICTION **c13**
Rene C. A. Zanbergen, John M. Dow, and Stuart D. Martin (Logica Space and Communications Ltd., Darmstadt, Germany, F.R.) *In its* Spacecraft Flight Dynamics Dec. 1991 p 495-500 (For primary document see N92-24719 15-12)
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The operational orbit determination subsystem for ERS-1 is described. Its definition and successful use since the ERS-1 launch are outlined. The subsystem design, the first orbit determination after launch and the injection accuracy are discussed. The routine orbit determination is described and the orbit determination and prediction accuracy are estimated. ESA

N92-24788# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.). Orbital Attitude Div.
ERS ORBIT CONTROL **c13**
Mats Rosengren *In its* Spacecraft Flight Dynamics Dec. 1991 p 501-513 (For primary document see N92-24719 15-12)
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The European remote sensing mission orbit control is addressed. For the commissioning phase, the orbit is defined by the following requirements: Sun synchronous, local time of descending node 10:30; three days repeat cycle with 43 orbital revolutions; overhead Venice tower (12.508206 deg east, 45.314222 deg north). The launch, maneuvers for the initial acquisition of the operational orbit, orbit maintenance maneuvers, evaluation of the orbit control, and the drift of the inclination are summarized. ESA

N92-24789# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
PROCESSING QUICK-LOOK LASER DATA FROM ERS-1 **c82**
P. Duque, John M. Dow, M. M. RomayMerino, and T. MartinMur (Grupo de Mecanica del Vuelo S.A., Madrid, Spain) *In its* Spacecraft Flight Dynamics Dec. 1991 p 515-519 (For primary document see N92-24719 15-12)
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The first European Remote Sensing (ERS) satellite contains a laser retroreflector that is very important for the success of the mission. Reconstitution of very precise orbits is essential to have a reference height for the altimeter measurements and to locate the measurements of the other instruments precisely in space. Some preliminary processing of the laser tracking already available with inhouse sofware is reported. A description of the data and some preliminary results are presented. ESA

N92-24790# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
ERS-1 IN-FLIGHT ATTITUDE PERFORMANCE VERIFICATION **c18**
X. Marc and L. Massonne (Mathematischer Beratungs- und Programmierungsdienst G.m.b.H., Dormund, Germany, F.R.) *In its* Spacecraft Flight Dynamics Dec. 1991 p 521-528 (For primary document see N92-24719 15-12)
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ERS-1, the first ESA Remote Sensing Satellite, is currently flying on a Sun synchronous orbit. Its three axis stabilized attitude is estimated and controlled by onboard software. During the commissioning phase of the spacecraft, an onground attitude restitution is needed to help calibrate some of the payload instruments. The approach and methods taken to perform this on ground attitude restitution task are outlined. ESA

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N92-24085*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
USE OF ELLIPTICAL ORBITS FOR A KA-BAND PERSONAL ACCESS SATELLITE SYSTEM
Masoud Motamedi and Polly Estabrook *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 83-89 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

N92-24305*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Navigation Systems Section.
ORBIT-DETERMINATION PERFORMANCE OF DOPPLER DATA FOR INTERPLANETARY CRUISE TRAJECTORIES. PART 1: ERROR ANALYSIS METHODOLOGY
J. S. Ulvestad and S. W. Thurman *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 31-48 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 22A

N92-24306*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Navigation Systems Section.
ORBIT-DETERMINATION PERFORMANCE OF DOPPLER DATA FOR INTERPLANETARY CRUISE TRAJECTORIES. PART 2: 8.4-GHz PERFORMANCE AND DATA-WEIGHTING STRATEGIES
J. S. Ulvestad *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 49-65 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 22A

N92-24461# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.). Automatic Control Dept.
SAFETY STRATEGY AND IMPLEMENTATION FOR THE RENDEZVOUS OF THE COLUMBUS FREE-FLYER WITH THE SPACE STATION FREEDOM
Arnd Kolkmeier and Wolfgang Schnetzer (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany F.R.) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 213-218 (For primary document see N92-24432 15-18)
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N92-24462# MATRA Espace, Toulouse (France).
USE OF THE DOCKING DYNAMICS TEST FACILITY FOR RENDEZVOUS AND DOCKING FINAL APPROACH VERIFICATION
P. Noirault and J. M. Pairot *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 219-224 (For primary document see N92-24432 15-18)
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N92-24464# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
MISSION AND VEHICLE MANAGEMENT AND FDIR FUNCTIONS FOR GNC SYSTEMS FOR RENDEZVOUS OPERATIONS
U. Soppa, J. Sommer, A. Tobias, M. Panicucci, and L. Olivier-Martin (MATRA Espace, Toulouse, France) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 231-236 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Fed. Republic of Germany (For primary document see N92-24432 15-18)
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N92-24468# MATRA Espace, Toulouse (France).
HERMES NAVIGATION AND ORBITAL GUIDANCE
Michel Frezet and Patrice Riant *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 261-269 (For primary document see N92-24432 15-18)
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N92-24479# Technion - Israel Inst. of Tech., Haifa. Faculty of Aerospace Engineering.
NEAR EARTH ORBIT DETERMINATION USING MAGNETOMETERS
I. Y. Bar-Itzhack and G. Shorshi *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 345-350 (For primary document see N92-24432 15-18)
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N92-24726# Adam Mickiewicz Univ., Poznan (Poland). Astronautical Observatory.
PRECISE ANALYTICAL THEORY OF AN ARTIFICIAL SATELLITE MOTION IN THE GRAVITY FIELD OF A PLANET
Edwin Wnuk *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 43-48 (For primary document see N92-24719 15-12)
(Grant NR-2-1239-91-01)
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N92-24727# Valladolid Univ. (Spain). Departamento de Matematica Aplicada a la Ingenieria.
REDUCING THE ERROR GROWTH IN THE NUMERICAL PROPAGATION OF SATELLITE ORBITS
Jose M. Ferrandiz, Jesus Vigo, and P. Martin *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 49-54 (For primary document see N92-24719 15-12)
(Grant CICYT-ESP88-541)
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N92-24729# Ceskoslovenska Akademie Ved, Ondrejov. Inst. of Astronomy.
ORBITAL PERTURBATIONS DUE TO THE ALBEDO EFFECT
L. Sehnal, D. Vokrouhlicky, and Jan Straka (GKSS-Forschungszentrum Geesthacht, Germany, F.R.) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 61-64 (For primary document see N92-24719 15-12)
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N92-24730# Zaragoza Univ. (Spain). Grupo de Mecanica Espacial.
AN EFFICIENT FORMULATION FOR NUMERICAL ORBIT COMPUTATION
A. Abad, M. Palacios, and M. Sein-Echaluce *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 65-70 (For primary document see N92-24719 15-12)
(Grants CICYT-PB90-0921; CICYT-ESP91-0919)
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N92-24733# Centre National d'Etudes Spatiales, Toulouse (France).
PRECISE ORBIT DETERMINATION WITH THE DORIS/SPOT2 SYSTEM: FIRST RESULTS
F. Nouel, J. P. Berthias, P. Broca, A. Comps, M. Deleuze, A. Guitart, C. Jayles, P. Laudet, C. Pierret, and A. Piuzzi et al *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 91-95 (For primary document see N92-24719 15-12)
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N92-24736# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.). Orbit Attitude Div.
COVARIANCE TRANSFORMATIONS AND GLOBAL ERRORS FOR ORBIT AND ATTITUDE
L. Fraiture *In its* Spacecraft Flight Dynamics Dec. 1991 p 113-124 (For primary document see N92-24719 15-12)
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N92-24738*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
COBE NAVIGATION WITH ONE-WAY RETURN-LINK DOPPLER IN THE POST-HELIUM-VENTING PHASE
Joan Dunham, M. Nemesure, M. V. Samii, M. Maher (Bendix Field Engineering Corp., Lanham, MD.), Jerome Teles, and J. Jackson *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 133-140 (For primary document see N92-24719 15-12)
(Contract NAS5-31500)
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N92-24739*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ORBIT DETERMINATION SUPPORT FOR HITEN'S AEROBRAKING IN THE EARTH'S ATMOSPHERE
L. Efron, J. Ellis, P. R. Menon, and B. Tucker *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 141-147 Sponsored by NASA, Washington (For primary document see N92-24719 15-12)
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N92-24740# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TESTING, ANALYSIS, AND ASSESSMENT OF OD SYSTEM SOFTWARE FOR THE FIRST BRAZILIAN SATELLITE
Helio Koiti Kuga and Rama Rao Kondapallo *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 149-153 (For primary document see N92-24719 15-12)
Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24743# Centre National d'Etudes Spatiales, Toulouse (France).
SURVEY ON SPOT-SYSTEM ORBIT-KEEPING EXPLOITATION (1986-1990)
Pascal Micheau *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 171-176 (For primary document see N92-24719 15-12)
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N92-24744# Centre National d'Etudes Spatiales, Toulouse (France).
ON-BOARD LOW EARTH-ORBIT DETERMINATION
C. Jayles and H. Renault (Aerospatiale, Cannes, France) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 177-179 (For primary document see N92-24719 15-12)
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N92-24746*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
GALILEO ATTITUDE DETERMINATION: EXPERIENCES WITH A ROTATING STAR SCANNER
L. Merken and G. Singh *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 203-211 (For primary document see N92-24719 15-12)
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N92-24747# Science Systems Ltd., Bristol (England).
HIPPARCOS: ATTITUDE DETERMINATION WITH TWO GYROS AND A STAR MAPPER
J. H. C. Auburn, A. J. Batten, and A. J. C. McDonald (Logica Ltd., London, England) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 213-220 (For primary document see N92-24719 15-12)
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N92-24753# Science Systems Ltd., Bristol (England).
ISO GROUND ATTITUDE DETERMINATION DURING OPERATIONS
A. J. Batten *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 259-264 (For primary document see N92-24719 15-12)
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N92-24769# Harbin Inst. of Tech. (China).
THE RESEARCH ON HIERARCHICAL CONTROL IN RENDEZVOUS AND DOCKING SYSTEM
A. D. Sheng, H. Z. Hu, and D. Wu *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 369-371 (For primary document see N92-24719 15-12)
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N92-24774# Royal Aerospace Establishment, Farnborough (England). Space Dept.
LIMITATION OF SPACE DEBRIS IN GEOSTATIONARY TRANSFER ORBIT
R. Crowther *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 397-402 (For primary document see N92-24719 15-12)
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N92-24787# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
ERS-1 OPERATIONAL ORBIT DETERMINATION AND PREDICTION
Rene C. A. Zanbergen, John M. Dow, and Stuart D. Martin (Logica Space and Communications Ltd., Darmstadt, Germany, F.R.) *In its* Spacecraft Flight Dynamics Dec. 1991 p 495-500 (For primary document see N92-24719 15-12)
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N92-24788# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.). Orbital Attitude Div.
ERS ORBIT CONTROL
Mats Rosengren *In its* Spacecraft Flight Dynamics Dec. 1991 p 501-513 (For primary document see N92-24719 15-12)
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14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N92-24512# Mitsubishi Electric Corp., Amagasaki (Japan). Central Research Lab.
DEVELOPMENT OF A HYBRID DOCKING DYNAMICS SIMULATOR
Masao Inoue, Jun Nakagawa, and Naomi Arima (Mitsubishi Electric Corp., Kamakura, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 601-606 (For primary document see N92-24432 15-18)
Copyright Avail: NTIS HC/MF A99

N92-24627# Swedish Space Corp., Kiruna.
NEW FACILITIES AT ESRANGE (SWEDEN)
Alf Wikstroem and Boerje Sjoeholm *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 225-227 (For primary document see N92-24589 15-12)
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N92-24629# Norwegian Space Center, Oslo.
AN INTEGRATED LAUNCH FACILITY FOR SOUNDING ROCKETS AND MICRO-SATELLITES
Rolf Skatteboe *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 231-236 (For primary document see N92-24589 15-12)
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N92-24632# Norwegian Space Center, Andenes. Andoeya Rocket Range.
NEW SERVICES AT ANDOYA (NORWAY) ROCKET RANGE
Ivar Nyheim *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 247-250 (For primary document see N92-24589 15-12)
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15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N92-25092*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
RESONANT MODE CONTROLLERS FOR LAUNCH VEHICLE APPLICATIONS

Ken E. Schreiner (General Dynamics Corp., San Diego, CA.) and Mary Ellen Roth 1992 8 p Presented at the Applied Power Electronics Conference and Exposition, Boston, MA, 23-27 Feb. 1992; sponsored by IEEE
(NASA-TM-105563; E-6887; NAS 1.15:105563) Avail: NTIS HC/MF A02 CSCL 22B

Electro-mechanical actuator (EMA) systems are currently being investigated for the National Launch System (NLS) as a replacement for hydraulic actuators due to the large amount of manpower and support hardware required to maintain the hydraulic systems. EMA systems in weight sensitive applications, such as launch vehicles, have been limited to around 5 hp due to system size, controller efficiency, thermal management, and battery size. Presented here are design and test data for an EMA system that competes favorably in weight and is superior in maintainability to the hydraulic system. An EMA system uses dc power provided by a high energy density bipolar lithium thionyl chloride battery, with power conversion performed by low loss resonant topologies, and a high efficiency induction motor controlled with a high performance field oriented controller to drive a linear actuator. Author

N92-25115# Sandia National Labs., Albuquerque, NM.
DESIGN AND PERFORMANCE OF SANDIA'S CONTACTLESS COILGUN FOR 50 mm PROJECTILES
Ronald J. Kaye, Eugene C. Cnare, M. Cowan, Billy W. Duggin, Ronald J. Lipinski, Barry M. Marder, Gary M. Douglas, and Kenneth J. Shimp (EG and G Energy Measurements, Inc., Albuquerque, NM.) 1991 7 p Presented at the 6th Symposium on Electromagnetic Launch Technology, Austin, TX, 28-30 Apr. 1992
(Contract DE-AC04-76DP-00789)
(DE92-009058; SAND-91-2158C; CONF-9204102-1) Avail: NTIS HC/MF A02

A multi-stage, contactless coilgun is being designed to demonstrate the applicability of this technology to accelerate nominal 50 mm (2 inch) diameter projectiles to velocities of 3 km/s. Forty stages of this design (Phase 1 coilgun) will provide a testbed for coil designs and system components while accelerating 200 to 400 gram projectiles to 1 km/s. We have successfully qualified the Phase 1 gun by operating 40 stages at half energy (10 kJ stored/stage) accelerating 340 gram, room-temperature, aluminum-armature projectiles to 406 m/s. We expect to accelerate 200 gram projectiles cooled to -196 C to three times this velocity when operating at full energy. This paper describes the design and performance of the Phase 1 coilgun and includes discussion of coil development, projectile design, capacitor banks, firing system, and integration. DOE

N92-24453# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
ATTITUDE AND ORBIT CONTROL ALGORITHM FOR MULTIPLE PAYLOAD LAUNCHERS
H. Strauch, H. Klotz, and A. Lopez-y-Diaz (Aerospatiale, Les Mureaux, France) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 151-156 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Fed. Republic Of Germany (For primary document see N92-24432 15-18)
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N92-24630# Guidance Dynamics Corp., Simi Valley, CA.
SINGLE UNIT INTEGRATION OF INERTIAL INSTRUMENTATION, DATA PROCESSING, AND INPUT/OUTPUT DEVICES FOR CONTROL OF SOUNDING ROCKETS
Richard Eric Rasmussen and Richard A. Bailey *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 237-242 (For primary document see N92-24589 15-12)
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N92-24631# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.).
ON-LINE CALCULATION OF THE INSTANTANEOUS IMPACT POINT OF SOUNDING ROCKETS DURING FLIGHT
L. Altenbuchner and M. Hafner *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 243-246 (For primary document see N92-24589 15-12)
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N92-24634# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.
ULTRA-SMALL SATELLITE AND LAUNCH VEHICLE
H. Matsuo, T. Hayashi (Chiba Inst. of Tech., Narashino, Japan), and H. Saito *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 257-260 (For primary document see N92-24589 15-12)
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N92-24635# Centro Tecnico Aerospacial, San Jose dos Campos (Brazil). Inst. de Aeronautica e Espaco.
DEVELOPMENT STATUS OF THE BRAZILIAN VLS SATELLITE LAUNCHER PROGRAM
Jayme Boscov, Paulo Moraes, Jr., Ariovaldo F. Palmerio, Luis R. DelMonaco, Benedito M. P. Furlan, and Toshiaki Yoshino *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 261-267 (For primary document see N92-24589 15-12)
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16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

N92-24978*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
STS-48 CASE STUDY, 17-18 SEPTEMBER 1991
Michael K. Atchison, Mark M. Wheeler, Gregory E. Taylor, and John D. Warburton 1992 76 p Original contains color illustrations
(Contract NAS10-11844)
(NASA-CR-190147; NAS 1.26:190147) Avail: NTIS HC/MF A05; 32 functional color pages CSCL 22B

Weather conditions are documented prior to and during the STS-48 attempted landing at the Shuttle Landing Facility at KSC on 18 Sep. 1991. Trends in meteorological data during 17 and 18 Sep. are examined along with their relationship to the overall weather pattern observed over the KSC region. The primary weather problems during the landing were the formation of showers within 10 nautical miles of the SLF and any ceiling less than 10,000 ft. The controlling factor of the weather was a high pressure ridge that was gradually weakening and moving off the northeast. As this occurred, the low level flow was switching from a easterly to a southeasterly direction. This change in wind direction was reflected by shower movement on the McGill radar and by trends in rawinsondes launched from the Cape. These rawinsondes also indicated that the boundary layers was becoming slightly more unstable several hours prior to the attempted landing which may have aided in the development of clouds and small isolated showers. Also, analyses of Doppler wind profiler and rawinsondes indicated a possible midlevel disturbance in the easterly flow pattern near 700 mb. This weak disturbance may have made the atmosphere a little more unstable early on 18 Sep. Finally, embedded within the southeasterly flow were several bands of

low clouds. These clouds were rather difficult to see in unenhanced IR satellite imagery available to forecasters in real time. However, post analyses using several different enhancement curves, adapted from NESDIS, clearly reveals the presence of these clouds.
Author

N92-24760# Academy of Sciences (USSR), Moscow. Inst. of Applied Mathematics.
DYNAMICS OF AEROSPACE SHUTTLES
Y. G. Sikharulidze, A. V. Burov, and V. S. Ladygin *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 307-310 (For primary document see N92-24719 15-12)
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17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N92-24307*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Navigation Systems Section.
THE X-WINDOWS INTERACTIVE NAVIGATION DATA EDITOR
G. C. Rinker *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 66-78 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 17G

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N92-24198*# North Carolina Univ., Charlotte. Dept. of Electrical Engineering.
SLEW MANEUVERS OF SPACECRAFT CONTROL LABORATORY EXPERIMENT (SCOLE) Final Report
Yogendra P. Kakad Apr. 1992 133 p
(Grant NAG1-535)
(NASA-CR-190228; NAS 1.26:190228) Avail: NTIS HC/MF A07 CSCL 22B

This is the final report on the dynamics and control of slew maneuvers of the Spacecraft Control Laboratory Experiment (SCOLE) test facility. The report documents the basic dynamical equation derivations for an arbitrary large angle slew maneuver as well as the basic decentralized slew maneuver control algorithm. The set of dynamical equations incorporate rigid body slew maneuver and three dimensional vibrations of the complete assembly comprising the rigid shuttle, the flexible beam, and the reflector with an offset mass. The analysis also includes kinematic nonlinearities of the entire assembly during the maneuver and the dynamics of the interactions between the rigid shuttle and the flexible appendage. The equations are simplified and evaluated numerically to include the first ten flexible modes to yield a model for designing control systems to perform slew maneuvers. The control problem incorporates the nonlinear dynamical equations and is expressed in terms of a two point boundary value problem.
H.A.

N92-24244*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ROBOT SERVICED SPACE FACILITY Patent Application
Lloyd R. Purves, inventor (to NASA) 23 Oct. 1991 47 p
(NASA-Case-GSC-13408-1; NAS 1.71:GSC-13408-1; US-Patent-Appl-SN-781625) Avail: NTIS HC/MF A03 CSCL 22B

A robot serviced space facility includes multiple modules which are identical in physical structure, but selectively differing in function and purpose. Each module includes multiple like attachment points which are identically placed on each module so as to permit interconnection with immediately adjacent modules. Connection is made through like outwardly extending flange assemblies having identical male and female configurations for interconnecting to and locking to a complementary side of another flange. Multiple rows of interconnected modules permit force, fluid, data and power transfer to be accomplished by redundant circuit paths. Redundant modules of critical subsystems are included. Redundancy of modules and of interconnections results in a space complex with any module being removable upon demand, either for module replacement or facility reconfiguration, without eliminating any vital functions of the complex. Module replacement and facility assembly or reconfiguration are accomplished by a computer controlled articulated walker type robotic manipulator arm assembly having two identical end effectors in the form of male configurations which are identical to those on module flanges and which interconnect to female configurations on other flanges. The robotic arm assembly moves along a connected set of modules by successively disconnecting, moving and reconnecting alternate ends of itself to a succession of flanges in a walking type maneuver. To transport a module, the robot keeps the transported module attached to one of its end effectors and uses another flange male configuration of the attached module as a substitute end effector during walking.
NASA

N92-24247*# Old Dominion Univ., Norfolk, VA. Engineering Mechanics.
PRELIMINARY STRUCTURAL DESIGN OF A LUNAR TRANSFER VEHICLE AEROBRAKE M.S. Thesis
Lance B. Bush (National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.) Feb. 1992 64 p
(NASA-TM-107828; NAS 1.15:107828) Avail: NTIS HC/MF A04 CSCL 22B

An aerobrake concept for a Lunar transfer vehicle was weight optimized through the use of the Taguchi design method, structural finite element analyses and structural sizing routines. Six design parameters were chosen to represent the aerobrake structural configuration. The design parameters included honeycomb core thickness, diameter to depth ratio, shape, material, number of concentric ring frames, and number of radial frames. Each parameter was assigned three levels. The minimum weight aerobrake configuration resulting from the study was approx. half the weight of the average of all twenty seven experimental configurations. The parameters having the most significant impact on the aerobrake structural weight were identified.
Author

N92-24349*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
APPLICATIONS OF HIGH THERMAL CONDUCTIVITY COMPOSITES TO ELECTRONICS AND SPACECRAFT THERMAL DESIGN
G. Richard Sharp and Timothy A. Loftin (DWA Composite Specialities, Inc., Chatsworth, CA.) 1990 8 p Presentd at the 13th International Communication Satellite Systems Conference, Los Angeles, CA, 11-15 Mar. 1990; sponsored by AIAA Previously announced in IAA as A90-25609
(Contract NAS3-24896)
(NASA-TM-102434; E-5175; NAS 1.15:102434; AIAA-90-0783)
Avail: NTIS HC/MF A02 CSCL 22B

Recently, high thermal conductivity continuous graphite fiber reinforced metal matrix composites (MMC's) have become available that can save much weight over present methods of heat conduction. These materials have two or three times higher thermal

conductivity in the fiber direction than the pure metals when compared on a thermal conductivity to weight basis. Use of these materials for heat conduction purposes can result in weight savings of from 50 to 70 percent over structural aluminum. Another significant advantage is that these materials can be used without the plumbing and testing complexities that accompany the use of liquid heat pipes. A spinoff of this research was the development of other MMC's as electronic device heat sinks. These use particulates rather than fibers and are formulated to match the coefficient of thermal expansion of electronic substrates in order to alleviate thermally induced stresses. The development of both types of these materials as viable weight saving substitutes for traditional methods of thermal control for electronics packaging and also for spacecraft thermal control applications are the subject of this report. Author

N92-24432# European Space Agency, Paris (France).
SPACECRAFT GUIDANCE, NAVIGATION AND CONTROL SYSTEMS
W. R. Burke, comp. Dec. 1991 610 p The 1st international conference was held in Noordwijk, Netherlands, 4-7 Jun. 1991 (ESA-SP-323; ISBN-92-9092-134-X; ISSN-0379-6566; ETN-92-91380) Copyright Avail: NTIS HC/MF A99

Papers on spacecraft Guidance, Navigation, and Control (GNC) systems are presented. Missions include the SOHO (Solar Heliospherical Observatory), Polar Platform AOCS (Attitude and Orbit Control System) Columbus, CRAF (Comet Rendezvous/Asteroid Flyby) and Cassini, Artemis and DRS (Data Relay Satellite), Rosetta, Data Relay Technology Mission (DRTM), SPOT, Polar Platform, and Cluster. Papers are divided under the following subheadings: missions; rendezvous and docking (RVD) systems; high accuracy; reentry/launchers; attitude measurement; RVD implementation; Hermes; verification; navigation; gimballed wheels; software/algorithms; FDIR (fault detection, isolation and recovery); analysis; in orbit experience. For individual titles, see N92-24433 through N92-24513.

N92-24433# British Aerospace Public Ltd. Co., Bristol (England). Earth Observation and Sciences Div.
DESIGN ASPECTS OF THE ATTITUDE CONTROL SYSTEM FOR THE SOHO SPACECRAFT
T. D. Wood and C. D. James *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 3-8 (For primary document see N92-24432 15-18)
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The Solar Helispherical Observatory (SOHO) spacecraft is to be placed in a halo orbit around the first Lagrangian point L1 of the Sun-Earth system. The orbit is inherently unstable and consequently requires tight control of delta-V magnitude and direction (25 arcseconds). Attitude control will allow points on the Sun to be observed with a stability of better than 0.8 arcseconds, while tracking the Sun spin axis with a (1 minute) stability of 18.9 arcseconds, in the presence of payload disturbances of 0.02 nms. The soho mission is outlined and the spacecraft and attitude system are described. The control law design adopted to meet the stringent pointing required is examined. ESA

N92-24434# MATRA Marconi Space, Toulouse (France).
POLAR PLATFORM AOCS
P. Riant *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 9-14 (For primary document see N92-24432 15-18)
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The Polar Platform is a very large spacecraft, compared to the existing European observation satellites, and is designed to support a great number of payloads. Although these dynamic characteristics lead to some new problems for the AOCS (Attitude and Orbit Control System), the proposed concept for the subsystem uses a lot of existing principles, modes and hardware units developed for the SPOT 4 and Helios program. The main hardware modifications concern the actuators capacity and the design of the solar array drive mechanism. ESA

N92-24435# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.). Automatic Control Dept.
GNC SUBSYSTEM DESIGN AND PERFORMANCE SIMULATION FOR THE COLUMBUS FREE-FLYER
Dieter Ulrich, Albrecht Woelker, and Ralf Hartmann *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 15-22 (For primary document see N92-24432 15-18)
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A summary of the functional and performance requirements for the GNC (guidance, navigation, and control) subsystem is given and the derived subsystem architecture as well as the concept and implementation aspects of the subsystem software are described. The modeling and analysis approach up to the GNC subsystem performance verification by simulation, based on the Multibody Interactive Dynamic Analysis Software ESA-MIDAS is described. Simulation results showing the achievable control performance for significant operations are presented. ESA

N92-24436*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ATTITUDE AND ARTICULATION CONTROL FOR CRAF/CASSINI
C. E. Bell, D. E. Bernard, and R. D. Rasmussen *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 23-32 Sponsored by NASA, Washington (For primary document see N92-24432 15-18)
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The Comet Rendezvous/Asteroid Flyby (CRAF) and Cassini planetary missions provide exciting pointing and control challenges. The mission and science objectives, and an attitude and articulation control concept designed to meet these challenges, are described. CRAF/Cassini mission characteristics which drive pointing and control include: close range flybys of asteroids and icy satellites; Huygens probe guidance and communication; Saturn orbit insertion; comet rendezvous and orbit insertion; closed loop target tracking from a comet orbit perturbed by gas and dust pressure; fine spacecraft pointing for Titan radar mapping and Earth communications; requirements for autonomous failure detection; isolation; recovery; and 13.5 year lifetime. The philosophy and approach chosen to meet these challenges and the overall control architecture are addressed, including operational and autonomous safe modes. Critical functions are highlighted, such as charge coupled device imaging of stars and extended bodies which provide references for inertial and target referenced pointing respectively. Tradeoffs and rationale for the selection and location of sensors and actuators are reviewed. ESA

N92-24437# MATRA Espace, Toulouse (France). Dynamics and Control Dept.
NEW AOCS CONCEPTS FOR ARTEMIS AND DRS
T. Duhamel and A. Benoit *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 33-39 (For primary document see N92-24432 15-18)
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The missions of the Artemis and DRS's (Data Relay Satellites) (both part of the Data Relay and Technology Mission (DRTM) program of ESA) lead to spacecraft configurations with disturbance torques not usually encountered in telecommunication satellites. Because of these specific disturbance torques, new concepts for attitude control were considered. The derivation of the concepts and justification of their selection for the Artemis and the DRS are shown. These concepts are evolved from the classical 'biased momentum' attitude control used on many geostationary satellites but provide a better capability of handling large torques due to: solar radiation pressure, moving antennas, or the use of ion propulsion. The proposed attitude control system (two degrees of freedom with solar sailing) will provide a large growth capability for future telecommunications satellites while retaining the essential features of classical attitude control systems. ESA

N92-24438# MATRA Espace, Toulouse (France).
DEVELOPMENT OF GNC SYSTEM FOR RENDEZVOUS: MAJOR RESULTS OF THE PRE-DEVELOPMENT PROGRAMME

J. M. Pairot, C. Pauvert, W. Fehse, A. Tobias, A. Getzschmann, and J. Sommer (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany, F.R.) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 43-53 (For primary document see N92-24432 15-18)
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The Rendezvous and Docking system Pre-Development Program (RVD-PDP) is part of an ESA technology program aiming at an early proof of concept of a rendezvous and docking system for Hermes and Columbus. One of the major activities of the RVD-PDP is the development of an onboard GNC (guidance, navigation, and control) system for RVD. Starting from Hermes and Columbus mission scenarios and requirements, RVD strategies, and maneuvers are defined. Taking into account existing functional concepts of Hermes and Columbus GNC systems, a generic concept of an autonomous, onboard GNC system for RVD, including the interaction of human operator in the GNC, are defined, performance and safety analyses are performed, and the required GNC algorithms established. Design and performance requirements for related equipment such as RV sensors, GNC processor, and docking system are derived, and task and performance allocation to chaser and target GNC and docking systems are established. The way in which the proof of concept (POC) is attempted, the development approach followed, the tools used, and the results obtained by analysis, simulation, and tests are described. ESA

N92-24439# National Space Development Agency, Ibaraki (Japan).
GUIDANCE, NAVIGATION, AND CONTROL STRATEGY IN A PROXIMITY RANGE FOR AUTONOMOUS RVD MISSION
Yasufumi Wakabayashi, Isao Kawano, Hiroyuki Suzuki, Norimasa Yoshida, Hiroaki Miyazaki, and Tatsushi Kanbe (Mitsubishi Electric Corp., Kamakura, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 55-60 (For primary document see N92-24432 15-18)
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Study results on autonomous rendezvous and docking (RVD) for unmanned spacecraft, intended for the first Japanese RVD system and the associated basic ideas on the Guidance, Navigation and Control (GNC) System in the relative/final approach and docking phase are outlined. Special emphasis is put on those aspects such as safety, standardized operation, and hierarchical and modular design of both Flight Management System (FMS) and Flight Control System (FCS). Some of the ideas, including a simultaneous standardization of flight path and operational modes, hierarchical control of GNC functions, and a simplified formulation of relative GPS (Global Positioning System) navigation filter, are discussed. Remarks on the present status of the study are included. ESA

N92-24440# MATRA Espace, Toulouse (France).
ADAPTIVE GUIDANCE TECHNIQUES FOR HERMES RENDEZVOUS
E. Desplats and C. Champetier *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 61-66 (For primary document see N92-24432 15-18)
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The main results of the research and development activity performed in the frame of Hermes rendezvous concerning the guidance and control strategies for the homing and closing phases are presented. The 'N boosts' trajectories are presented, and the terminal point guidance concept is discussed in comparison to the more classical guidance on a reference trajectory, which was proved to be less performant (mainly for ergol consumption) and less robust (to thruster and navigation failures). The results are illustrated with simulation outputs issued from a dedicated rendezvous simulator (with realistic GPS (Global Positioning System) navigation and thruster control modelization). ESA

N92-24441# MATRA Espace, Toulouse (France).
ON-BOARD ASSISTANT FOR GNC MONITORING DURING RENDEZVOUS OPERATIONS
A. deSaint-Vincent, M. LeDu (Centre National d'Etudes Spatiales, Toulouse, France), P. Caloud, and M. Frezet *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 67-72 (For primary document see N92-24432 15-18)
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A decision support system designed to help the astronauts of the European Spaceplane Hermes during the orbital rendezvous maneuvers is described. The system provides the astronauts with two main features, a high level fault isolation and recovery function, and a mission replanning function. A supervision module helps to make short term decisions and advise the users to use the diagnostic and mission replanning modules according to the current state of the vehicle. The whole decision support system is connected to a simulator of the Hermes GNC (Guidance, Navigation, and Control) function which allows various scenarios of malfunctions occurring during the closing phase of the rendezvous to be tested. First experimentations highlighted the real need of these high level decision support tools, and the basic concepts of the system were validated. The described system is extendible to all the in orbit operations and could very interestingly be used for training. ESA

N92-24442# Ministry of International Trade and Industry, Tokyo (Japan). Electrotechnical Lab.
CONTROL OF FREE FLYING SPACE ROBOT FOR CAPTURING MANEUVER
Kazuo Machida, Yoshitsugu Toda, Toshiaki Iwata, Nobuyuki Kubota, Kiyoshi Ioi, Takashi Katsuragawa, Nobuyoshi Muroi, and Kenji Ogimoto (Kawasaki Heavy Industries Ltd., Kakamigahara, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 73-78 (For primary document see N92-24432 15-18)
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A series of maneuvers for satellite capturing task are addressed to study the control strategy of a free flying space robot with dual arm. The first maneuver of the robot is to approach a target. The resolved motion rate control method using the generalized Jacobian matrix has been suggested for arm slue of a base free space robot. A control method using inertial sensor feedback for arm slue instead of using a generalized Jacobian to reduce the computational load and to increase robustness, is proposed. The second maneuver is to capture a moving target. The simulation technique which represents the contact and grasping process including momentum exchange, is developed. The arm control method for soft catching, using impedance control, is studied. These control maneuvers are investigated by using a body referenced dynamic model of a planar dual arm flying robot with joint flexibility. ESA

N92-24443# Italspazio, Rome (Italy).
GPS DIFFERENTIAL NAVIGATION TECHNIQUES FOR CARINA REENTRY AND SPACECRAFT RENDEZVOUS OPERATIONS
G. Barresi, L. Caporicci, and C. Soddu *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 79-86 (For primary document see N92-24432 15-18)
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Absolute GPS (Global Positioning System) navigation techniques are adaptable in the operational and experimental phases of most missions; GPS autonomous navigation allows the use of independent procedures to perform many onboard operations without any ground command. The dedicated ground segment can be reduced and the experimental data can be transmitted to the ground station during short period of visibility. Differential GPS operations greatly reduce the effects of selective availability, ionosphere, troposphere and other slow varying errors for users both in a local area around a reference station and between two users performing their relative navigation by differencing their absolute measurements. This technique can profitably be used during specific periods such as reentry phase or rendezvous operations due to the enhanced performances achievable. The results of studies on the usability of the GPS for the relative navigation between two space vehicles and on trajectory determination of a reentry vehicle are presented. ESA

N92-24444*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE PRECISION SEGMENTED REFLECTORS: MODERATE MISSION FIGURE CONTROL SUBSYSTEM c19
G. Sevaston, D. Redding (Draper, Charles Stark Lab., Inc., Houston, TX), K. Lau, W. Breckenridge, B. Levine, N. Nerheim, S. Sirlin, and H. Kadogawa *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 89-96 Sponsored by NASA, Washington (For primary document see N92-24432 15-18)
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A system concept for a space based segmented reflector telescope figure control subsystem is described. The concept employs a two phase architecture in which figure initialization and figure maintenance are independent functions. Figure initialization is accomplished by image sharpening using natural reference targets. Figure maintenance is performed by monitoring the relative positions and alignments of the telescope components using an optical truss. Actuation is achieved using precision positioners. Computer simulation results of figure initialization by pairwise segment coalignment/cophasing and simulated annealing are presented along with figure maintenance results using a wavefront error regulation algorithm. Both functions are shown to perform at acceptable levels for the class of submillimeter telescopes that are serving as the focus of this technology development effort. Component breadboard work as well as plans for a system testbed are discussed. ESA

N92-24445# MATRA Espace, Paris-Velizy (France). Automatic Studies.
THE ATTITUDE AND ORBIT CONTROL SYSTEM ON THE ARISTOTELES SATELLITE
P. Peyrot *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 97-101 (For primary document see N92-24432 15-18)
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The feasibility studies and the preliminary design of the attitude and orbit control and propulsion subsystems (AOCS/RCS (Rate Control System)) for the Aristoteles satellite, as defined in phase A studies, are summarized. The main design drivers for the AOCS are the acceleration stability requirement (10(exp -7) rd/sq s, 5 x 10(exp -7) rd/sq s in the range of 0.005 to 0.125 Hz), and the magnetometer attitude determination accuracy (20 arcseconds); operating on a very low altitude orbit (200 Km) is an additional constraint. The proposed AOCS concept allows the autonomy required by orbit altitude. Fine attitude control is achieved using low noise gyros and low disturbance reaction wheels with PID controller. Star sensors provide measurements for the fine attitude estimation. The capability of drag control is specific to Aristoteles; it is achievable by control of the cross section area with deployable flaps. An attitude yaw steering mode is possible to minimize the disturbances from lateral aerodynamics forces. The RCS design drivers are the total impulse requirement to achieve the various orbit corrections and maintenance, and the fuel management requirement to limit dynamic disturbance and motions of the center of mass. The selected hydrazine RCS has a storage capacity about 1000 kg; the tanks have elastomeric membrane to limit fuel motions. A continuous estimation of individual tank consumption is achieved which allows the balancing of the fuel mass in the various tanks. An assessment of the peformances of the AOCS/RCS is shown to validate the concepts. ESA

N92-24446# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.).
ACTIVE SUSPENSION GROUND TEST FACILITY FOR LARGE FLEXIBLE STRUCTURE DYNAMICS AND CONTROL INVESTIGATIONS
T. Lange and C. Schlegel *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 103-108 (For primary document see N92-24432 15-18)
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Starting out from current trends and developments in ground testing of controlled large space structures, a new approach based upon active suspension technology is presented. The facility currently being developed employs spring type devices with positive feedback about equilibrium providing a rated low stiffness compliance along the suspension degree of freedom. The mechanical system utilizes software controlled force motors with lightweight moving parts and sensors for displacement and dynamic differential force feedback. Gravity compensation in a limited frequency range is realized via high speed decentralized signal processors each dedicated to a cluster of suspension units. A potential spinoff application of the inhouse developed linear motor is the handling of objects under zero g conditions. ESA

N92-24447# Vrije Univ., Brussels (Belgium). Dept. of Applied Mechanics.
ACTIVE DAMPING BY A LOCAL FORCE FEEDBACK WITH PIEZOELECTRIC ACTUATORS
Andre Preumont, Jean-Paul Dufour, and Christian Malekian *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 109-115 (For primary document see N92-24432 15-18)
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Research in the field of active damping of space structures is summarized. The test facility consists of a truss structure provided with two active elements that can be placed in various locations. Each of the active elements consists of a linear piezoelectric actuator collocated with a force transducer. Each active element is controlled in a decentralized manner, with an integral feedback of the force in the voltage applied to the piezo-actuator. This control law is always stable and is found to be very effective: the damping ratio of the first mode was increased from 0.003 (open loop) to 0.09 with one actuator. ESA

N92-24448# British Aerospace Public Ltd. Co., Bristol (England). Earth Observation and Science Div.
THE MULTI-DISCIPLINARY APPROACH FOR FUTURE VERY HIGH POINTING ACCURACY AOCS
W. J. Alldridge *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 117-122 (For primary document see N92-24432 15-18)
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The traditional approach to spacecraft subsystem design is to treat each subsystem as a separate entity. The impact of missions requiring very high pointing accuracy was to force a reappraisal of this approach. The need to actively control payload disturbances drives AOCS (Attitude and Orbit Control System) bandwidth to the point at which flexure modes must be stabilized rather than rejected as in the past. Also, the effects of thermoelastic structural distortions in distributed AOCS units has now become a determining factor. A program to investigate and evaluate these issues is described in relation to the Horizon 2000 FIRST project. ESA

N92-24449# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
AOCS SCENARIOS FOR LOW COST RE-ENTRY CAPSULES
H. Sondermann *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 125-130 (For primary document see N92-24432 15-18)
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AOCS (Attitude and Orbit Control System) scenarios for low cost reentry capsules are addressed. Moderately sized reentry capsules are equipped with a solid deboost engine in order to provide space for maximum payload mass and volume. This fact largely influences the definition of the attitude measurement system, and the overall control strategies involved. Major topics discussed are the transition from the orbital phase to the deorbit maneuver and, particularly in case of a spin stabilized deboost, the final orientation to a stable reentry attitude, that is, two maneuvers where severe accuracy requirements and time constraints exist. ESA

N92-24450# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.).
GUIDANCE AND CONTROL FOR RE-ENTRY VEHICLES

W. Buhl and D. Paris (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk Netherlands) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 131-136 (For primary document see N92-24432 15-18)
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An orbiter entry guidance system for the hypersonic phase of reentry lead to a concept which is partially different from that of the U.S. Shuttle. The addressed flight regime ranges from the initial atmospheric penetration point down to an Earth relative velocity of about 700 m/s at which point the control is transferred to the terminal area energy management system. A guidance concept is embedded in a closed loop simulation environment, which enables an investigation of its performance and especially its robustness with regard to various assumed errors and perturbations, is described. The guidance concept presumes the presence of precalculated nominal trajectories. ESA

N92-24451# MATRA Espace, Toulouse (France).
TRAJECTORY OPTIMISATION AND GUIDANCE STRATEGIES FOR REENTRY
S. Jallade, T. Duhamel, and C. Champetier *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 137-144 (For primary document see N92-24432 15-18)
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The emergence in Europe of missions involving reentry for atmospheric transfer trajectories has spawned the need for general purpose software to optimize these trajectories. The envisaged software must be able to accept a wide variety of models, optimization criteria and constraints. A study in which the dynamics, atmosphere, aerodynamics and heat flux models were selected to be implemented in the software as well as a number of cost functions and constraints is presented. The available numerical techniques to solve the associated control problems are surveyed and a direct collocation method is selected because of its versatility and robustness. In order to verify the validity of the choices made, some test cases were performed with simplified models which confirmed the robustness of the method. The application of the method to onboard real time adaptive guidance is considered. ESA

N92-24452# National Space Development Agency, Ibaraki (Japan).
THE ORBITAL RE-ENTRY EXPERIMENT VEHICLE, AND THE FLIGHT EXPERIMENT OF GPS NAVIGATION FOR HOPE
T. Izumi, I. Kawano, Y. Takizawa, K. Masuda, T. Mori, and K. Kito (Mitsubishi Heavy-Industries Ltd., Nagoya, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 145-150 (For primary document see N92-24432 15-18)
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The Japanese H2 Orbiting Plane (HOPE) is an unmanned winged space vehicle which is planned to be launched in the end of 1990s. The Orbital Reentry Experiment (OREX) for acquiring engineering data for HOPE is presented. The experiment is planned to be carried out in early 1993. The vehicle is inserted into low Earth orbit by H2 rocket test flight. After about one revolution, it will deorbit and reenter the atmosphere. Global Positioning System Receiver (GPSR) is the key component for the navigation system of HOPE. A five-channel experimental GPSR model is installed in OREX as mission equipment, and the engineering data are obtained for the design of the HOPE's GPSR. The OREX mission, vehicle system, and guidance and control system are addressed. HOPE navigation system and the GPS experiment plans on OREX are presented. ESA

N92-24453# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
ATTITUDE AND ORBIT CONTROL ALGORITHM FOR MULTIPLE PAYLOAD LAUNCHERS **c15**
H. Strauch, H. Klotz, and A. Lopez-y-Diaz (Aerospatiale, Les Mureaux, France) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 151-156 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Fed. Republic Of Germany (For primary document see N92-24432 15-18)
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The attitude and orbit control algorithm for the upper stage of a multiple payload launcher is described. The mission of the launcher is to put several payloads into an orbit. The payload may be released in a three axis stabilized or spinning mode. The unknown dispersions (dynamic unbalance and thrust level) and the changing configuration during the sequence requires novel features in the control algorithm: the estimation of the dynamic unbalance after each release, a special filter for the accelerometer output, and gain scheduling of the observer and filter gains. ESA

N92-24454# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
FALKE: WINGED RE-ENTRY VEHICLE FLIGHT CONTROL
Klaus-Dieter Relotius and Gaston Netter *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 157-162 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Fed. Republic of Germany (For primary document see N92-24432 15-18)
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The analysis and design of GNC (Guidance, Navigation, and Control) algorithms of winged reentry vehicles like Hermes is based on the knowledge of aerodynamic forces and torques. The properties, i.e., the coefficients for the prediction of aerodynamic coefficients and their derivatives, is one of the most difficult tasks. This is due to the complex coupling beteen kinematics, aerodynamics, and thermodynamics. An understanding of the interdependencies is needed to enable a realistic analysis of flight performance and flight qualities. The prediction of aerodynamic properties is generally obtained by numerical methods. The verification of the results is acquired by wind tunnel tests. In practice the verificiation turns out to be rather difficult mainly due to the lack of wind tunnel capability to simulate the correct Reynolds and Mach number ranges. An alternative method to obtain aerodynamic coefficients and their derivatives is to perform free flight tests with a scaled down flight model. Predefined maneuvers are executed. The offline analyses of flight data provides the unknown coefficients. To prove the feasibility of this method is one of the main objectives of the FALKE project. ESA

N92-24455# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
DEVELOPMENT AND TEST OF THE ASTRO-SPAS ATTITUDE MEASUREMENT AND CONTROL SYSTEM
N. Gradmann, A. Boeinghoff, E. Bruederle, G. Elsner, L. Kaffer, and H. Widmann *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 165-172 (For primary document see N92-24432 15-18)
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Astro-Spas, a free flying carrier of scientific experiments, is equipped with a high precision attitude measurement and control system. The onboard software is developed using the C programming language as an integral part of an overall simulation program and then transferred directly into the onboard computer. The development, test methods, and the experience gained with the new approach are reported. ESA

N92-24456# Kayser Threde G.m.b.H., Munich (Germany, F.R.).
DEVELOPMENT OF THE MAXUS-1 ARCS USING FIBRE-OPTIC GYROS **c19**
B. Eisfeller, G. Schmitt, and A. Lissner *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 173-178 (For primary document see N92-24432 15-18)
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MAXUS-1 is a large sounding rocket for microgravity research. The MAXUS Service Module (MSM) includes an Attitude and Rate Control System (ARCS). The RCS function of the ARCS is to despin the experiment payload after separation of the motor and to keep it nonrotating in the microgravity phase. Because of

possible high lateral body rates after burnout and until motor separation, large angular deflections of the payload roll axis from the local vertical may occur. In this situation the ARCS function is activated, which will drive the payload back into a 45 deg cone around the vertical, in order to use high gain portions of the antenna pattern for adequate television transmission. The MAXUS-1 ARCS consists of three body mounted fiber optic gyroscopes, a microcomputer based on the 68020 CPU and a cold gas reaction system. The computer performs a high speed (1 kHz) quaternion update algorithm including scaling and compensation of the gyro signals, coning correction and Euler angle extraction. The digital controller is of a three point relais type with hysteresis, which activates and deactivates the two stage cold gas system. ESA

N92-24457# Centre National d'Etudes Spatiales, Toulouse (France).

ATTITUDE MEASUREMENT AND STAR LINE OF SIGHT: FROM ON-GROUND EXPERIMENT TO FLIGHT RESULTS c19

O. Vandermarcq *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 179-187 (For primary document see N92-24432 15-18)

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Three kinds of experiment are described. Attitude determination oriented studies are based on the Sed 12 star sensor use. The first experiment is dedicated to fine attitude determination on the basis of gyro and star sensor data hybridation. The strapdown gyro and star sensor can measure one axis rotations induced by a one axis table motion. Five stars are simulated. Inflight scale factor gyro performance of calibration is studied. Objectives of the second experiment are to realize a functional simulation of a closed loop attitude and orbit control system simulation including a physically real star sensor stimulation. The 'MAPSS' bench developed was open and closed loop tested for a geostationary satellite. The Sigma inflight experiment is described. The French gamma telescope launched on the Soviet Granat satellite in Dec. 1989, is equipped with two CCD (Charged Coupled Device) star sensors. Some inflight results concerning the star sensors operations and performances are given. ESA

N92-24458# Satellites International Ltd., Newbury (England).

LOW COST SPACECRAFT ATTITUDE SENSORS c19

M. R. Leese, A. K. Ward, S. Paice, and S. Heyhoe *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 189-194 (For primary document see N92-24432 15-18)

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With the increasing interest in small satellites there is a growing requirement for low cost attitude sensing and control systems. The development of such a low cost attitude sensing system, suitable for spinning spacecraft is described. The attitude sensor system uses fan beam Sun and Earth albedo sensors based on those used successfully on the Active Mesospheric Particle Tracer Explorer (AMPTE) mission. The sensors interface to an electronics module which records the timing of the triggers on the Sun and Earth, which data can then be processed for attitude determination. The system is to be flown on the Space Technology Research Vehicle (STRV-1) currently under development. STRV-1 is to be launched in early 1993 into a Geostationary Transfer Orbit (GTO). The sensors and electronics module are designed to withstand the GTO high radiation environment whilst minimizing the power requirements. The electronics module are designed to withstand the GTO high radiation environment whilst minimizing the power requirements. The electronics module employs Field Programmable Gate Array (FPGA) devices which are inherently radiation hard. The way in which attitude reconstruction is performed by software running on the onboard computer or by ground based software is described. Further development of attitude sensing and control systems, including a low cost digital Sun sensor suitable for three axis stabilized spacecraft, is described. ESA

N92-24459# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.

AUTONOMOUS STAR IDENTIFICATION AND SPACECRAFT ATTITUDE DETERMINATION WITH CCD STAR TRACKERS c19

T. E. Strikwerda, H. L. Fisher, C. C. Kilgus, and L. J. Frank *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 195-200 Sponsored by Army Engineer Topographic Labs. (For primary document see N92-24432 15-18)

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Star trackers employing CCDs (Charge Coupled Devices) are currently being developed for precise attitude reference for several satellites. A technique developed for autonomously identifying stars and determining attitude in real-time using simultaneous measurements of three to five stars obtained with this type of tracker is described. The technique is to be demonstrated on a satellite experiment. Processing techniques are summarized, and results from field tests of one tracker are presented. The methods discussed can be applied to a wide range of missions requiring precise, all sky, autonomous attitude determination. ESA

N92-24460# MATRA Espace, Toulouse (France).

VERIFICATION TESTS FOR A PROTOTYPE RVD GNC ON-BOARD SOFTWARE c61

C. Pauvert, J. Tailhades, U. Soppa, F. Kruse, R. Gloerfeld, T. VanOverbeek, and F. Ankersen (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 203-211 (For primary document see N92-24432 15-18)

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During the predevelopment program of a Rendezvous and Docking (RVD) system, part of an RVD Proof of Concept (RVD-POC), an RV control system concept that encompasses the Hermes and Columbus concepts was developed. An essential part of the RV control system is the onboard RV control software which includes mission and vehicle management, failure detection isolation and recovery functions, and Guidance, Navigation, and Control (GNC) functions proper. Early proof of the selected concepts will be provided in the current RVD-POC in two steps. In the first, the onboard RV control software was integrated with a high fidelity, non-real-time dynamics and environment simulator for detailed performance verification. The resulting RVD Onboard System Simulator (ROSS) will be able to test all Hermes and Columbus scenarios. In the second step, the most critical RVD mode was coded in Ada and integrated on a breadboard onboard computer for real time tests. ESA

N92-24461# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.). Automatic Control Dept.

SAFETY STRATEGY AND IMPLEMENTATION FOR THE RENDEZVOUS OF THE COLUMBUS FREE-FLYER WITH THE SPACE STATION FREEDOM c13

Arnd Kolkmeier and Wolfgang Schnetzer (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany, F.R.) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 213-218 (For primary document see N92-24432 15-18)

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The mission of the Columbus Free Flyer includes active rendezvous maneuvers with the International Space Station Freedom. This imposes challenging safety requirements, which drive the design of the autonomous GNC (Guidance, Navigation, and Control) subsystem. The rendezvous safety philosophy is based on the safe trajectory principle. This means that, at any point in time, propulsion shutoff will lead to a free drift trajectory that does not intersect the flight path of Space Station Freedom. This concept allows a separation of nominal flight control functions from those functions required for safety check and abort of the rendezvous. The rendezvous scenario and the safety related requirements are reviewed and the proposed safety strategy and its hardware and software implementation in the GNC of the Columbus Free Flyer are shown. ESA

N92-24462# MATRA Espace, Toulouse (France).
USE OF THE DOCKING DYNAMICS TEST FACILITY FOR RENDEZVOUS AND DOCKING FINAL APPROACH VERIFICATION **c13**
P. Noirault and J. M. Pairot *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 219-224 (For primary document see N92-24432 15-18)
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The Docking and Dynamics Test Facility (DDTF) and its current areas of investigation are reviewed. The following topics are described: tests of an automatic scenario with a closed loop control of the approach to docking using a RV (Rendezvous) sensor breadboard; tests with a representative mockup of the future Docking/Berthing System (DBS), to derive relevant allocation between the GNC (Guidance, Navigation, and Control) system performances and the DBS capabilities; and tests on the last 5 m translation with full human control of the chaser for the Hermes/Columbus mission, where astronauts performed the docking mission. Some recommendations for a future dynamical test bench are given in conclusion. ESA

N92-24463# Mitsubishi Electric Corp., Hyogo (Japan).
AUTONOMOUS CAPTURE EXPERIMENT OF FREE-FLYING TARGET ON THE GROUND SIMULATOR
H. Shimoji, M. Inoue, K. Ninomiya, I. Nakatani, and J. Kawaguchi (Tokyo Univ., Sagamihara, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 225-230 (For primary document see N92-24432 15-18)
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In order to develop a free flying robot, a motion simulator is developed in which a 0 G environment is simulated in real-time by combining a numerical simulation based on the law of momentum conservation and servomechanisms. On the simulator an experimental free flying robot is constructed which consists of two CCD (Charge Coupled Device) cameras and a manipulator. It is confirmed through experiments that this robot can automatically acquire the target state information using a Kalman filter for the images and directing the manipulator to capture the free flying target even, if the robot itself is freely flying. ESA

N92-24464# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
MISSION AND VEHICLE MANAGEMENT AND FDIR FUNCTIONS FOR GNC SYSTEMS FOR RENDEZVOUS OPERATIONS **c13**
U. Soppa, J. Sommer, A. Tobias, M. Panicucci, and L. Olivier-Martin (MATRA Espace, Toulouse, France) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 231-236 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Fed. Republic of Germany (For primary document see N92-24432 15-18)
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In the forthcoming European scenarios of LEO (Low Earth Orbit), spacecraft will perform frequent complex rendezvous and proximity operations maneuvers. The ESA set up a RVD (Rendezvous and Docking) Proof of Concept program (RVD-POC) aimed at the definition and verification of RVD concepts that encompass those of the Hermes and Columbus projects. The approach to collision avoidance, in the scenarios covered by the RVD-POC, and the concepts defined for Mission and Vehicle Management (MVM) and Failure Detection Isolation and Recovery (FDIR) are described. The verification approach for these and other GNC related concepts, and the planned tests and expected results in the RVD-POC on these matters are presented. ESA

N92-24465# British Aerospace Public Ltd. Co., Stevenage (England).
ARIANE TRANSFER VEHICLE (ATV) GUIDANCE, NAVIGATION, AND CONTROL CONCEPTS
E. Fyfe, D. Salt, C. Bonnal, and F. Theiller (Aerospatiale, Les Mureaux, France) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 237-242 (For primary document see N92-24432 15-18)
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An outline of the GNC (Guidance, Navigation, and Control) subsystem of the Ariane Transfer Vehicle (ATV) is given. The ATV system is aimed at providing a cost effective means of meeting the logistics requirements of a space station or other low Earth orbit activities. A typical mission involves rendezvous and berthing with the space station to deliver cargo. The vehicle can remain berthed for up to 6 months before departing. The vehicle is finally deorbited on a controlled trajectory designed to allow it to burn up over nonpopulated areas. ESA

N92-24466# Centre National d'Etudes Spatiales, Toulouse (France).
HERMES GUIDANCE, NAVIGATION, AND CONTROL SYSTEM FOR RENDEZVOUS PHASES
G. Brondino and J. Legenne *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 245-255 (For primary document see N92-24432 15-18)
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The Hermes mission and design constraints are reviewed and the Hermes GNC (Guidance, Navigation and Control) system is described. The specific functions and strategies developed for each phase of the mission (phasing-homing/closing-final approach) are presented and discussed in terms of general architecture and processing algorithms. Derived from simulations, the GNC performances are presented according to the different steps of the mission. Simulations incorporating all the GNC functions are performed, in nominal or degraded situations, to assess the global GNC subsystem performances, and check the rendezvous feasibility. Maneuvers strategies suited to the different rendezvous phases are explained, as the associated trajectory control laws which have been defined to reduce dispersions caused by navigation and maneuvers achievement errors, with the minimum propellant consumption and with respect to time schedule. The manual backup modes studied for rendezvous final approach are described. ESA

N92-24467# Aerospatiale, Les Mureaux (France). Space and Strategic Systems Div.
MANAGEMENT OF NAVIGATION MEANS FAILURE IN HERMES SPACE VEHICLE
M. C. Capdevielle and T. Abensur *In* ESA, Spacecraft Gudiance, Navigation and Control Systems Dec. 1991 p 257-260 (For primary document see N92-24432 15-18)
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Hermes space vehicle uses a complex navigation system involving numerous items of onboard equipment (Inertial Measurement Units stellar sensors, rendezvous sensors, radio altimeters, etc.) and external means (Global Positioning System/Data Relay Satellite, Trident 4 beacons) necessary to ensure accuracy, reliability and security constraints during all flight phases: launch, orbit and reentry. The treatment of navigation means failure has to comply with these high level requirements and must avoid too high complexity to allow simple development and verification. The Hermes navigation system is described phase by phase. Principles of failure management are given, including segregation, location of votes, and use of backup systems. Various types of failure treatment are depicted, such as hot or cold redundancy, failure detection isolation and recovery, and fault tolerance. General principles of voting techniques are described. Space avionics constraints are qualitatively taken into account regarding several aspects: computer voting constraints, reusability or not of partially failed chains, guidance, navigation and control computation load, and data exchange between computers. The described principles can be generalized to other space avionic systems using hybridation techniques associated to redundancies, as far as manned or unmanned transportation systems are concerned. ESA

N92-24468# MATRA Espace, Toulouse (France).
HERMES NAVIGATION AND ORBITAL GUIDANCE **c13**
Michel Frezet and Patrice Riant *In* ESA, Spacecraft Guidance,

Navigation and Control Systems Dec. 1991 p 261-269 (For primary document see N92-24432 15-18)
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An overview of the concepts for the Hermes navigation and orbital guidance is presented. The whole mission scenario from the launch alignment operations until the landing is described. The navigation system selected and designed for Hermes is presented. Particular emphasis is put on the rendezvous and on the reentry navigation. Attention is paid to the elaboration of the guidance strategies for the orbital maneuvers and for the rendezvous phases. Performances obtained in the frame of the Hermes Phase C1 system studies are presented. ESA

N92-24469# Aerospatiale, Les Mureaux (France). Div. of Space and Strategic Systems.

OBJECTIVE PROPELLANT CONSUMPTION AND THRUSTERS ACTIVATIONS FOR THE ATTITUDE CONTROL OF THE HERMES-COLUMBUS COMPOSITE **c20**

C. Billant-Guillaumin, J. Magne, and J. M. Seguin *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 271-276 (For primary document see N92-24432 15-18)
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During the docked phase to the Columbus Free Flyer Laboratory (CFFL), the Hermes Space Vehicle (HSV) is required to perform the attitude control of the composite (HSV + CFFL) vehicle, keeping its longitudianl axis orientated towards the Sun. Because of its duration and of the profile of perturbating torques associated with the required pointing mode, this phase impacts widely on the propellant budget of the HSV and on the number of activations to be delivered by its front thrusters. A method to define realistic objectives is introduced as a guide for the design studies of the Hermes attitude control. The optimal propellant consumption during docked phase is calculated, taking into account the actual Hermes propulsive architecture. An activations strategy maximizing the duration of attitude free drift during two consecutive commutations, and allowing the propellant consumption to be maintained not far from the optimum is described. Simulation results are given for verification purpose. The proposed activations strategy is possibly an interesting basis for future development of spacecraft control laws. ESA

N92-24470# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Communications and Propulsion Systems Div.

DESIGN OF HERMES MANUAL CONTROL MODES

K. Janschek, E. Lehrl, and W. Oesterlin *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 277-286 (For primary document see N92-24432 15-18)
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A key issue within the frame of the development activities for the Hermes Orbital Flight Control (OFC) function deals with the design of manual control modes. These modes realize the direct piloting of the space vehicle by sidesticks. Manual control modes can be activated during the free orbital flight and the rendezvous phase. The nominal manual modes incorporate three and six degrees of freedom closed loop commands for control torques and forces. The design of the nominal manual modes includes a feedforward/feedback architecture with special emphasis on optimized feedforward control schemes with respect to intelligent sidestick command handling. The development of these modes is performed on a special realtime simulation environment with specific sidestick and animation functions which allow for an assessment of the control performance with respect to man-in-the-loop operation. Simulation results demonstrate the capabilities and performance of the current design. ESA

N92-24471# Aerospatiale, Les Mureaux (France). Space and Strategic Systems Div.

ROBUST CONTROL OF AN AERODYNAMICALLY UNSTABLE LAUNCHER WITH BENDING MODES

S. Besset and P. Delpy *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 287-292 (For primary document see N92-24432 15-18)
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The application of H(infinity) control theory to the design of robust control laws for an aerodynamically unstable launcher is explored. A specific robust control design methodology is presented. The new approach incorporates nonlinear multiparameter variations in the state space formulation of H(infinity) control theory. The controller design technique is successfully applied to an aerodynamically unstable launcher whose dynamical behavior along a reference trajectory is modeled taking into account the angle of attack deviation, the thruster gimbal axis deflection and the bending modes. A robust controller is designed in order to stabilize the nominal system and the perturbed one with parameter uncertainties on the main aerodynamic coefficient, in the gimbal effectiveness coefficient and on the bending modes frequencies. The focus is on the use of the synthesis technique as a powerful loop shaping tool to yield frequency domain properties known to be desirable. ESA

N92-24472# Telespazio, S.p.A., Rome (Italy).

DESCRIPTION AND SIMULATION RESULTS OF THE ITALSAT AOCS ADVANCED FLIGHT SIMULATOR

G. Lenzo, R. L. Minciotti, and M. Sasso *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 295-303 (For primary document see N92-24432 15-18)
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IAFSIM, a real time closed loop simulator of the Italsat Attitude and Orbit Control Subsystem (AOCS), is described. Conventional applications are discussed and the main results of several IAFSIM simulation runs, which cover the main AOCS modes of operation during the various Italsat mission phases, are presented. The simulation results are compared with the actual AOCS test results highlighting the possibility of tuning the IAFSIM to reproduce with high fidelity the real AOCS performances. IAFSIM possible future applications are described, including implementation and testing of nonconventional control philosophies for attitude control in case of primary failures. The development of algorithms using the IAFSIM as a fundamental tool of research is demonstrated. ESA

N92-24473# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

ARCHITECTURAL DESIGN OF A TEST ENVIRONMENT FOR AOCS APPLICATIONS **c61**

C. Marscholik and U. Schwan (GAUSS G.m.b.H. und Co., Salem, Germany, F.R.) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 305-310 (For primary document see N92-24432 15-18)
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An architectural design of a test environment for AOCS (Attitude and Orbit Control Subsystem) applications is proposed. This environment will support specific AOCS applications for different missions. Based on the results of the AESOD (AOCS Executive Software Design) study, a testbed for functional and real time testing can be utilized. The architecture and the realized solution of this testbed are presented. Test results on its workload to the dedicated AOCS processor are shown. ESA

N92-24474# Officine Galileo S.p.A., Florence (Italy).

FULL MACS CONTROLLER-BASED SELF TEST MODULE FOR SPACECRAFT UNITS AND RELATED TESTING FACILITIES

G. Borghi, P. Brazzale, M. Brunamonti, M. Mancini, and S. Tosi (Protech, Florence, Italy) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 311-313 (For primary document see N92-24432 15-18)
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The development of a Self Test Module (STM) for IRES sensor and the related Electronic Ground Support Equipment (EGSE) is described. STM is an embedded general purpose testing module for space equipment; the IRES sensor is the first application. As a result of the work carried out, a method to design and develop a general purpose test station for MACS (Modular Attitude Control System) interfaced devices is described. ESA

N92-24475# British Aerospace Public Ltd. Co., Stevenage (England).
A FIBRE OPTIC IMPLEMENTATION OF MACS BUS **c74**
D. J. Morris, M. J. Baker, F. v.Fischer-Treuenfeld, H. G. Sparringa, and P. Brazzale (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk Netherlands) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 315-319 (For primary document see N92-24432 15-18)
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The main characteristics and performance of the original MACS (Modular Attitude Control System) databus concept can be met or surpassed using a fiber optic system. The optimum configuration for the databus is established as consisting of a dedicated data line from all users to a central clock station and an encoded clock and data distribution from the clock station to all users. At data rates of 500 Kbits/sec, bus lengths of up to 50 m can be achieved between the central clock station and any user; hence, a distance of 100 m between users can be realized. ESA

N92-24476# Nippon Electric Co. Ltd., Yokohama (Japan). Aerospace System Div.
TEST SYSTEM FOR FINE ATTITUDE CONTROL SYSTEMS OF ASTRONOMY SATELLITES
K. Fujiwara, T. Kawahara, T. Saitoh, and K. Ninomiya (Tokyo Univ., Sagamihara, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 321-326 (For primary document see N92-24432 15-18)
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A high energy solar physics satellite (Solar-A), an X ray astronomy satellite (Astro-D), and a space Very Long Base Interferometry (VLBI) satellite (Muses-B) are currently under development. Among the astronomy satellite series, especially high accuracy pointing control is required for the three satellites. The ACS (Attitude Control System) is important because it guarantees the performance and reliability of the ACS in orbit. This test requires the accurate and quick response dynamics simulator. The approach to the dynamics simulator using personal computers is described. The strategy of the ACS tests of the astronomy satellites, that effectively insures the performance and reliability, is presented. ESA

N92-24477# VEGA Space Systems Engineering Ltd., Harpenden (England).
ADVANCED IDENTIFICATION TECHNIQUES APPLIED TO VALIDATION OF SATELLITE ATTITUDE AND ORBIT CONTROL SYSTEMS
R. Marley *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 327-332 (For primary document see N92-24432 15-18)
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An essential activity during the integration of satellite hardware is the estimation and validation of the dynamic characteristics of the Attitude and Orbit Control System (AOCS), to prove that units interface as required and to demonstrate the robustness of the subsystem in the simulated operating environment. The duration of dynamic tests at system level as part of the Integrated System Test (IST) can be excessive; consequently there are significant benefits in optimizing the test philosophy and automating the approach as far as possible. The application of system identification techniques to AOCS validation is demonstrated. Several algorithms are discussed, their performance is demonstrated by simulation, and their practical feasibility is assessed. ESA

N92-24478*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
AUTONOMOUS GPS/INS NAVIGATION EXPERIMENT FOR SPACE TRANSFER VEHICLE (STV)
Triveni N. Upadhyay, Stephen Cotterill (Mayflower Communications Co., Inc., Reading, MA.), and A. Wayne Deaton *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 335-344 (For primary document see N92-24432 15-18)
(Contracts NAS8-38479; N00014-88-C-2326)
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An experiment to validate the concept of developing an autonomous integrated spacecraft navigation system using on board Global Positioning System (GPS) and Inertial Navigation System (INS) measurements is described. The feasibility of integrating GPS measurements with INS measurements to provide a total improvement in spacecraft navigation performance, i.e. improvement in position, velocity and attitude information, was previously demonstrated. An important aspect of this research is the automatic real time reconfiguration capability of the system designed to respond to changes in a spacecraft mission under the control of an expert system. ESA

N92-24479# Technion - Israel Inst. of Tech., Haifa. Faculty of Aerospace Engineering.
NEAR EARTH ORBIT DETERMINATION USING MAGNETOMETERS **c13**
I. Y. Bar-Itzhack and G. Shorshi *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 345-350 (For primary document see N92-24432 15-18)
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Near Earth spacecraft autonomous navigation using magnetometer measurements is presented. An orbit state vector comprised of six Keplerian elements, enables the estimation of the instantaneous orbital elements and the spacecraft position within a few km by a relatively simple formulation of an extended Kalman filter algorithm. Two kinds of measurements are examined: the magnitude of the magnetic field vector which can be used when there is no accurate knowledge of the spacecraft attitude and the magnetic field vector components which reduce the level of estimation errors and convergence time. The estimation algorithm presented was successfully applied to real satellite data obtained from the mgnetometer readings of the Earth Radiation Budget Satellite (ERBS). ESA GR

N92-24480# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.). Automatic Control Dept.
THE COLUMBUS FREE-FLYER GNC HIGH PRECISION GPS NAVIGATION IN SPACE
Ralf Hartmann and Guenter Peuker (Standard Elektrik Lorenz A.G., Stuttgart, Germany, F.R.) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 351-358 (For primary document see N92-24432 15-18)
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The satellite based Navstar Global Positioning System (GPS), to be used as the primary navigation system onboard the Columbus Free Flying Laboratory, is addressed. Besides the absolute navigation, special emphasis is put on the determination of position and velocity relative to the rendezvous target. For this purpose the relative GPS method is to be used, which means that the navigation solution for the relative position is based on the raw (uncorrected) GPS measurements of two GPS receivers, one onboard the target and one onboard the chaser. An overview of the Free Flyer mission is given and the resulting navigation requirements and the achievable navigation performance are summarized. The principle of GPS navigation is explained with emphasis on relative GPS. The design of a spaceborne GPS receiver and its integration into the GNC subsystem architecture is presented. ESA

N92-24481# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
APPLICATION OF GPS FOR HERMES RENDEZVOUS NAVIGATION
E. T. Hesper, B. A. C. Ambrosius, R. J. Snijders, and K. F. Wakker *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 359-368 (For primary document see N92-24432 15-18)
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A study of the application of the Navstar Global Positioning System (GPS) for rendezvous and docking in Low Earth Orbit (LEO), which required precise real time relative orbit determination,

is presented. The study was performed for a typical rendezvous mission between the European Spaceplane Hermes and the Columbus Free Flying Laboratory (CFFL). The investigations comprise a covariance analysis of the relative orbit determination problem of the two spacecraft from Kalman filter processing of GPS pseudo range data acquired by receivers onboard the spacecraft. A method to derive the relative position and velocity errors from the absolute state vector covariances is described. An overview of the simulated orbit determination approach and the adopted error model is given. The results of various numerical simulations are discussed using both pure pseudo ranges and differenced observations. It is shown that with standard S code receivers, three dimensional absolute position accuracies of the order of 50 to 200 m and relative position accuracies of the order of a few meters can be achieved during the closing phase from 500 km distance. The associated velocity errors are about 10 to 30 cm/s and 1 cm/s, respectively. The overall concept of using GPS is proven to be quite feasible. It continues to operate satisfactorily under degraded conditions. With extremely precise P code receivers, the relative position accuracy during final approach may be sufficient to control even docking operations. ESA

N92-24482# Fairchild Space Co., Germantown, MD. Guidance, Navigation and Control Dept.

DOUBLE GIMBALLED MOMENTUM WHEEL DESIGN FOR SMALL SATELLITES **c19**

Mohammed Shamma and Theodore Michaelis *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 369-391 (For primary document see N92-24432 15-18)

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Research on the need for a small volume versatile Double Gimballed Momentum Wheel (DGMW) compatible in weight and power with the burgeoning small satellite market is addressed. Spacecraft attitude actuators historically comprised three single axis reaction wheels for a zero momentum system and a single momentum wheel for a bias momentum. The system simulation and parametric design factors are presented, showing the advantages of a DGMW over single axis configurations. Size and overall mass (including power equivalent mass) are minimized by the DGMW. The results show the significance of the effects of the control structure interaction on the system stability and attitude performance. By modeling DGMW using the design methodology derived, the overall spacecraft attitude performance is stable and well behaved in response to environmental and impulse disturbance torques. ESA

N92-24483# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (Germany, F.R.).

A DOUBLE GIMBALLED MAGNETIC BEARING MOMENTUM WHEEL FOR HIGH POINTING ACCURACY AND VIBRATION SENSITIVE SPACE APPLICATIONS **c19**

U. J. Bichler *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 393-398 (For primary document see N92-24432 15-18)

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A fully controlled magnetic bearing momentum wheel is well suited as gyroscopic actuator in the attitude control system of spacecraft. It offers the following advantages: an active tilting of the momentum vector with respect to the spacecraft ('vernier gimballing') with the following features: very little power required; three axis attitude control of the spacecraft in a fine pointing range with only one wheel on a control moment gyro mode; no separate nutation damping device necessary; cross momentum storage capability; active vibration suppression, enabling isolation of unbalance vibrations of the wheel from the spacecraft which meets the increasing demand for quiet wheels which can be used in microgravity and in manned space missions; active damping of flexible structures through fully controllable translational bearing forces. The MW-X, a five degree of freedom magnetic bearing momentum wheel incorporates all these advantages and is ideally suited to support all high pointing accuracy and vibration sensitive space missions. Possible applications are communication satellites, especially those with inclined orbit, satellites with optical communication links, microgravity missions, space telescopes and high resolution Earth observation satellites. In long term manned space missions low noise wheels can reduce the effect of vibrations and the associated noise on the spacecraft environment and crew. ESA

N92-24484# Fokker Space and Systems, Amsterdam (Netherlands). Attitude Control Dept.

DESIGN AND DEVELOPMENT OF THE SAX-AOCS CONTROL SOFTWARE **c61**

Sytze Kampen and Jan Kouwen *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 401-406 (For primary document see N92-24432 15-18)

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The AOCS (Attitude and Orbit Control System) design and development of SAX, an Italian/Dutch program to be launched at the end of 1993, is addressed. The software development requires special attention in the areas of development approach and control algorithms. Many parties are involved in the development of the software for the SAX AOCS software. To manage this situation special attention was paid to the phasing of the development of the software and to the standardization of development methods and tools. The large size of the solar panels of SAX generates flexible modes at low frequencies, which drives the design of the control law. ESA

N92-24485# Fokker Space and Systems, Amsterdam (Netherlands).

EXPERIENCES WITH Ada IN ISO-AOCS **c61**

P. G. Beerthuizen and M. J. A. Oort *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 407-411 (For primary document see N92-24432 15-18)

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The use of Ada in the programming of the onboard software of the ISO (Infrared Space Observatory) satellite's Attitude and Orbit Control System (AOCS) is addressed. Despite the fact that it is the first European space flight application to be launched using Ada, and the target environment is a small embedded real time system, the experiences are generally very positive. The language made it possible not only to define unambiguous virtual processors on a strongly hierarchically structured design, but also to actually implement the level of data abstraction and information hiding that is required for a smooth development and testing of such a system. A more widespread application is recommended. ESA

N92-24486# British Aerospace Public Ltd. Co., Stevenage (England).

SOFTWARE TO SUPPORT ATTITUDE MEASUREMENT SYSTEM DESIGN **c61**

Colin Rogers and Roger Lowes *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 413-418 (For primary document see N92-24432 15-18)

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Measurement is an important aspect of attitude control system design, and is very dependent on configuration, orbital geometry and mission requirements. In order to facilitate the design of Attitude Measurement Systems (AMS) a general purpose analysis tool was developed which models configuration, orbital geometry and mission requirements. The AMS software was designed to provide a detailed performance analysis and error breakdown by source through a sequence of orbital operations, while minimizing the work required by the user to specify the system. It also supports investigations of sensor calibration and filtering methods, of benefit throughout system design and operations planning phases of a project. The software is able to represent a wide range of AMS systems including inertial, partly inertial, and momentum bias. ESA

N92-24487# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Attitude and Orbit Control Section.

OBJECT ORIENTED HARDWARE SIMULATION OF SPACECRAFT CONTROL ALGORITHMS **c61**

A. T. Sund, I. Halvorsen, O. Roedseth, B. Foss, and B. Polle (MATRA Espace, Toulouse, France) *In its* Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 419-429 (For primary document see N92-24432 15-18)

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The development of a complete simulation system, which integrates plant (spacecraft and environment) simulation and digital controller simulation is reported. A modular concept which uses MATRIX integrated with closed loop hardware models implemented in the C++ object oriented language was developed. As an illustrative example of the use of this simulation tool, the reformulation and simulation of the control loop of the SILEX laser telescope FPA (Fine Pointing Assembly), implemented in assembly and C on a high speed Digital Signal Processor (DSP), is prepared. The digital controller is simulated using both object oriented hardware models and real hardware, and the results are compared. Various data formats have been tested. The comparison shows the simulation has high numerical accuracy, and offers good execution time estimates. ESA

N92-24488# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).

MODE MANAGEMENT AND RUN-TIME-LINKING WITH Ada IN REAL-TIME **c61**

R. Gerlich *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 431-436 (For primary document see N92-24432 15-18)

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A concept on 'task execution' and 'mode management' which aims to minimize the dynamics needed for mode and task management is presented. It provides the capability for 'continuously' running (cyclic) tasks even in the case of a mode transition. No task has to be stopped in this case. All features can be used in a 'hard' real time environment. A three phase approach is applied to manage mode transitions: a preparation phase for the new mode, a deactivation phase for the old mode and (full) operational phases for both modes before and after a mode switch. The concept supports mode switching between two consecutive task cycles and the data sharing between modes and logically independent procedures. Software reconfiguration can be done within a few microseconds only. Online update of software and data sharing between new and replaced software is possible. These capabilities are provided by run time linking with Ada; they are not avaialable in Ada a priori. Via run time linking online reconfiguration is possible within a few microseconds. A demo program implementing the concept in Ada is available. ESA

N92-24489# Honeywell, Inc., Minneapolis, MN.

DISTRIBUTED HEALTH MANAGEMENT SYSTEMS FOR GUIDANCE, NAVIGATION, AND CONTROL (GNC) APPLICATIONS

J. Wald, J. Schoess, and G. Hadden *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 439-445 (For primary document see N92-24432 15-18)

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Future missions involving launch vehicle and space systems require available and reliable Guidance, Navigation and Control (GNC) systems. Availability is increased through health monitoring systems capable of first predicting and detecting faults and then expediting maintenance and repair. Advances in sensor, microelectronic and software technology permit increased system monitoring, failure prediction and detection within the GNC system. These advances make it possible to design and develop distributed health management systems. Smart sensors and predictive diagnostic algorithms have already been demonstrated. The development of computationally efficient data filtering and analysis algorithms will facilitate the integration of robust diagnostics within low power microelectronics. Plans are in place to embed this software in smart sensor electronics. ESA

N92-24490# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Attitude and Orbit Control Section.

ADVANCED FAULT TOLERANT AOCS COMPUTER FOR RENDEZVOUS AND DOCKING MISSIONS **c60**

A. T. Sund, J. Tailhades, and P. Linden (Saab Space A.B., Goeteborg, Sweden) *In its* Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 447-454 (For primary document see N92-24432 15-18)

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The design of an ultrareliable fault tolerant AOCS (Attitude and Orbit Control System) computer, the AGCP (Advanced Guidance, rendezvous, and Control Processor), is described. This computer has autonomous FDIR (Fault Detection, Isolation and Recovery) functions, and is able to recover very rapidly during proximity operations. A Fail Operational/Fail Safe (FO/FS) requirement applies to the AOCS/GNC (Guidance, Navigation and Control) subsystem. A complete three processor (one processor simulated) breadboard system was built and tested for use for real time, closed loop tests within a rendezvous and docking scenario. The major part of the system and application software was written in Ada. The system software design is described. Experience gained during software design, coding, integration and test is discussed. ESA

N92-24491# Fokker Space and Systems, Amsterdam (Netherlands).

FAULT DETECTION ISOLATION AND RECOVERY WITHIN THE AOCS OF SAX **c61**

A. M. Selig (Space Research Organization Netherlands, Utrecht.) and L. Karsten *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 455-459 (For primary document see N92-24432 15-18)

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In order to cope with the limited processing capacity of the AOCS (Attitude and Orbit Control System) computer and with limited budgets for AOCS hardware, both hardware redundancy and functional redundancy have been applied. As a result, the autonomous actions necessary for recovery vary from switching to a redundant hardware unit to reconfigured data handling. A reliable, relatively simple, and easy to verify FDIR (Fault Detection, Isolation and Recovery) system for the SAX (X-ray astronomy satellite) AOCS is therefore aimed at. Detection of failures of the hardware units is based on continuity checks on the output data and consistency checks on the output data of different units. Autonomous FDIR procedures were incorporated for the actuators and sensors, for the attitude control computer, and for the MACS (Modulator Attitude Control System) intelligent data communication bus of the AOCS. The architecture of the AOCS redundancy management and the dedicated health checks, malfunctioning criteria and recovery actions for some of the units are presented. In particular, recent insight in MACS fialure modes and associated recovery measures are outlined. ESA

N92-24492# Tokyo Univ., Sagamihara (Japan). Inst. of Space and Astronautical Science.

ATTITUDE AND ORBIT CONTROL SYSTEM OF THE VSOP MISSION SPACECRAFT MUSES-B

K. Ninomiya, T. Hashimoto, T. Kurii, and N. Ogura (Nippon Electric Co. Ltd., Yokohama, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 461-465 (For primary document see N92-24432 15-18)

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Muses B is a Japanese space VLBI (Very Long Baseline Interferometry) satellite to be launched in 1995 by the first flight of the Mu 5 launch vehicle now under development. The program is called VSOP (VLBI Space Observatory Program). Since only one ground station, at Uchinoura, Japan, is available for commanding the spacecraft, onboard automatic operation and fail-safe capability are strongly required. On the other hand, weight

restriction does not allow much redundancy to be adopted. The Attitude and Orbit Control System (AOCS) is described with emphasis on how onboard automation and fail safe operations are achieved to a maximum extent without depending on redundant hardwares. ESA

N92-24493# VEGA Space Systems Engineering Ltd., Harpenden (England).
OBJECT-ORIENTED SIMULATION IN DIAGNOSIS AND RECOVERY FROM FAULTS IN SPACECRAFT SUBSYSTEMS: AN EXPERIMENTAL APPLICATION OF THE OLYMPUS AOCS
R. S. Thompson and P. L. Silvestrin (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 467-472 (For primary document see N92-24432 15-18)
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Work on the feasibility of developing expert systems, which can automatically generate the contingency recovery procedures required to diagnose and recover from an entire class of predictable failure cases onboard an orbiting spacecraft is discussed. This is based on a layered, object oriented model of the spacecraft subsystem concerned, combining structural, behavioral and strategic knowledge. A case study for the Olympus AOCS (Attitude and Orbit Control System) is described. Replacement of the expert system's strategic layers with alternative rule sets, could lead to similar tools being used for operability and failure mode analysis during design, amongst other uses, and ultimately offers the prospect of onboard automated fault detection, isolation and recovery. ESA

N92-24494# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
CONTROL STRATEGIES FOR SPACE SYSTEMS
S. Stornelli, J. Ramakrishnan, H. Rajiyah, and A. Silva (Agusta S.p.A., Milan, Italy) *In its* Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 475-482 (For primary document see N92-24432 15-18)
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Methodologies for optimization of control structure synthesis are proposed for a class for structures which can be modeled as an assemblage of frame and truss elements. It is assumed that the structure and control system can be represented as a linear model. Three different approaches are proposed: local control structure optimization wherein feedback gains associated with local controllers are treated as design variables and the objective function is taken as the total controller forces and constraints are imposed on maximum dynamic displacements and individual local controller forces; an integrated Modal Cost Analysis (MCA) Output Variance Constraints (OVC) approach wherein an LQ controller is designed iteratively subject to L(2) and L(infinity) constraints on outputs based in the truncated modes of the structure (based on MCA approach); a global full state (LQR) control structure optimization approach where minimization of a linear combination of structural mass and controller energy is carried out subject to constraints on the natural frequency of the structure. The actuators and sensors are assumed to be collocated for the local controller problem. ESA

N92-24495# MATRA Espace, Toulouse (France).
MODERN CONTROL TECHNIQUES FOR SPACECRAFT AOC/GNC SYSTEMS
C. Champetier, E. Desplats, and P. Pelipenko (Centre National d'Etudes Spatiales, Toulouse, France) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 483-490 (For primary document see N92-24432 15-18)
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The results of studies dedicated to the applicability of modern control techniques to future spacecraft AOC/GNC (Attitude and Orbit Control/Guidance, Navigation and Control) systems are presented. A (nonexhaustive) review of current and future space missions which are likely to claim for the utilization of modern control theory is performed. A set of modern control techniques among the most promising ones is presented. The applicability of these methods to space control systems is discussed. Two typical applications selected for practical evaluation of modern control techniques and comparison with classical ones are described. ESA

N92-24496# Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany, F.R.).
SPACECRAFT ATTITUDE CONTROL USING MAGNETIC TORQUERS AND GAS JETS
R. Prigge, H. Klotz, and H. Strauch *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 491-496 Prepared in cooperation with Erno Raumfahrttechnik G.m.b.H. Bremen, Fed. Republic of Germany (For primary document see N92-24432 15-18)
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The attitude control of a spacecaft in low Earth orbit, equipped with magnetic torques and gas jets, is described. Starting with the determination of the theoretical minimum propellant mass required, optimum control laws are derived. A number of control strategies are investigated, different with respect to the use of a priori knowledge of the gravity gradient torque, and to various techniques for disturbance torque estimation. Magnetic field estimation of geostationary orbits is also addressed. ESA

N92-24497# British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.
TRAJECTORY CONTROL OF AN ORBITING TWO LINK FLEXIBLE MANIPULATOR SYSTEM
F. Karray, V. J. Modi, and J. K. Chan *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 497-502 Sponsored by Center of Excellence Programs (For primary document see N92-24432 15-18)
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Nonlinear dynamics and control of a class of space station based mobile flexible two link manipulators, normally referred to as the Mobile Servicing System (MSS), are studied. The governing nonlinear, nonautonomous and coupled equations of motion and the modal discretization procedure are described. A parametric response study suggests situations with unacceptable levels of deflections and accelerations for certain proposed missions, as well as station libration and payload positioning errors. An inverse control technique is proposed to achieve high tracking accuracy of the MSS in presence of maneuver induced disturbances. The control strategy is so designed as to regulate the libration of the Space Station as well as to insure joints tracking of prescribed trajectories, while limiting the effect of the structural vibration during large slewing maneuvers of the MSS. Two different control schemes, both based on the feedback linearization technique, are developed and their relative merit assessed. ESA

N92-24498# MATRA Espace, Paris-Velizy (France). Automatic Studies.
PERFORMANCE OF AN ATTITUDE AND RATE IMPROVED ESTIMATOR FOR AN EARTH OBSERVATION SATELLITE
S. Fritz *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 503-507 (For primary document see N92-24432 15-18)
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An Earth observation maneuvering satellite with stringent a priori and a posteriori pointing requirements is addressed. Attitude and rate estimation is achieved on board through an adaptive Kalman filter, using two axes dry tuned gyroscope and star sensor measurements. Gyroscope measurements are processed to predict the evolution of a state vector, which is then updated by star sensor measurements. Star sensor noise level can be predicted knowing the characteristics of the star (magnitude). Then a real time optimization of updating gains is possible. But pointing performances during high rate maneuvers are very sensitive to gyroscope scale factor and alignment errors. That is why a 15 states Kalman filter is implemented, estimating 3 attitudes, 3 drifts and 9 combinations of scale factor and misalignment. These state

variables are not updated, so that a state variable is estimated only when disturbances due to modelization error (in particular thermoelastic deformations) allow it. Attitude and rate a posteriori performances are improved by ground algorithms (go-and-back Kalman filter) using telemetry data. Performance evaluation and optimization of this estimator are performed using an analogy between Kalman filter and least squares algorithm behaviors. An analytic budget method was achieved to determine the impact of different typical errors (bias, drift, sine on sensor, gyroscope measurements etc.) on pointing and rate performances. Simulations show the advantage of implementing UD factorization algorithm. ESA

N92-24499# Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Lab. des Signaux et Systemes.
ON THE NONLINEAR ADAPTIVE CONTROL OF A FLEXIBLE SPACECRAFT
G. Georgiou, S. DiGennaro, S. Monaco (Rome Univ., Italy), and D. Normand-Cyrot *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 509-514 Sponsored in part by Italian Ministry of University and Scientific Technologial Research and Commission of the European Communities (For primary document see N92-24432 15-18)
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Gradient type adaptation laws, together with a certainty equivalence control law derived from nonlinear decoupling and linearization techniques, are applied to the model of a spacecraft with flexible appendages in order to achieve asymptotic tracking on the presence of unknown parameters. Uncertainties in the inertia tensor and on the modal parameters (natural undamped frequencies and damping coefficients) are considered. The proposed control scheme is shown to asymptotically track the desired reference trajectories for large attitude maneuvers, ensuring the whole control system stability. Simulation results are discussed. ESA

N92-24500# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
IN-FLIGHT PERFORMANCE OF THE ROSAT ATTITUDE MEASUREMENT AND CONTROL SYSTEM
W. Schrempp, E. Bruederle, and L. Kaffer *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 517-525 (For primary document see N92-24432 15-18)
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ROSAT, launched on June 1, 1990 has opened a new area of X ray astronomy. Up to now it has performed an all sky survey of X ray sources and is now on the pointing phase where detailed investigations of selected targets are performed by pointing its telescopes to them. The attitude measurement and control subsystem was designed to work autonomously to a large extent with a measurement accuracy of a few arcseconds and a control accuracy of a few arcminutes. The highlights and the difficulties and countermeasures taken during the first year of orbital operation are described. ESA

N92-24501# Eutelsat, Paris (France).
EUTELSAT 2 ATTITUDE AND ORBIT CONTROL EXPERIENCE
S. A. Glynn and L. R. Pattinson *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 527-534 (For primary document see N92-24432 15-18)
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The attitude and orbit control experience gained with the first two Eutelsat satellites is described. The main satellite characteristics are introduced. The different operational modes are addressed with a design summary followed by the operational experience. Reference is made to flight data taken from the transfer orbit and on station control centers. A section on the station keeping experience is presented which includes strategies developed and accuracies achieved. ESA

N92-24502# Centre National d'Etudes Spatiales, Toulouse (France).
IN ORBIT MICROVIBRATION TESTS ON SPOT-1 SATELLITE EXPERIMENT PRINCIPLE AND RESULTS
A. C. deGaujac, D. Monteil, and C. Bousquet *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 535-538 Prepared in cooperation with MATRA Marconi Space, Toulouse, France (For primary document see N92-24432 15-18)
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Microvibration effects on a line of sight attitude stability appear to become a significant constraint for several future missions. The overall performance is highly sensitive to the amplification factor brought by the structural distortions. Orbit microvibration tests on a SPOT 1 satellite were performed in order to characterize the structural damping factor of a spacecraft's major eigenmodes in orbital conditions under a very low dynamic environment. The experiment principle consists in the comparison of two images of the same area taken in the same conditions: same instrument, same aspect angle, same position on orbit. The first image is used as a reference, while the second one is disturbed by a calibrated dynamics disturbance. SPOT 1 images are a very good microvibration sensor since they are sampled at a 600 Hz frequency. Special attention was put on the geographic areas selection for the images which allowed to decrease the correlation noise to a very low level. The dynamic disturbance was generated by a random sequence of torque commands on a reaction wheel, while the AOCS (Attitude and Orbit Control System) control was inhibited. Thus, the disturbance signal had a large spectrum range where the NASTRAN analyses of SPOT 1 on orbit behavior had computed the major spacecraft eigenmodes. The spectrum of disturbance on the images compared to NASTRAN prediction allowed a good damping factor order of magnitude characterization. ESA

N92-24503# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
OTS-2 END-OF-LIFE DYNAMICS TESTS
L. C. VanHoltz, A. G. Bird, and I. T. Mitchell (VEGA Space Systems Engineering Ltd., Harpenden, England) *In its* Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 539-544 (For primary document see N92-24432 15-18)
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OTS-2, ESA's Orbital Test Satellite launched in May 1978, was placed into a graveyard orbit approximately 320 km above geosynchronous height during the first week of January 1991. After reorbiting, extensive end of life tests relating to the dynamics of the spacecraft were performed. Various nutation control strategies at intermediate and large nutation angles were investigated before placing the spacecraft into a flat spin condition. ESA

N92-24504# British Aerospace Public Ltd. Co., Stevenage (England).
SOME ASPECTS OF THE ATTITUDE AND ORBIT CONTROL SUBSYSTEM OF THE OLYMPUS SPACECRAFT
P. D. Wadey, P. E. Miles, and R. K. Lowes *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 545-549 (For primary document see N92-24432 15-18)
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The Olympus spacecraft was launched in 1989 with a number of new and interesting feature's in attitude and orbit control design. The AOCS (Attitude and Orbit Control System) is described and results obtained with the AOCS in transfer orbit are given. The normal and station keeping modes are discussed together with a novel method of performing east-west station keeping developed during the early months of the mission. The results of analysis of the solar array flexible modes using inflight data from an accelerometer package and the gyros is presented, and a comparison of actual sloshing induced momentum and torques with the predicted values from the Olympus AOCS simulator linked to Flow-3d (three dimensional flow software) is given. ESA

N92-24505# Sira Inst. Ltd., Chislehurst (England).
THE ROSAT STAR TRACKER: FLIGHT EXPERIENCE
David Purll, Norbert Gradmann, and Manfred Bollner (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, Germany, F.R.) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 551-556 (For primary document see N92-24432 15-18)
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A high precision star tracker was developed for the attitude measurement and control system of the German X-ray astronomy satellite ROSAT, launched on June 1, 1990. This star tracker has a basic pointing mode accuracy of around 1 arc second and a noise equivalent angle of around 0.5 arc second per axis in a 5.9 by 4.4 degree field of view, whilst tracking stars down to 7th magnitude. It also has to operate with reduced accuracy in the sky survey phase of the mission, when stars scan across the field of view on a given direction with a rate of up to 5 deg./min. The performance exceeds specification as demonstrated by ground test and flight data reported. The star tracker is a solid state instrument based on a CCD (Charge Coupled Device) image sensor. It has been qualified since 1985, and is the highest accuracy solid state tracker flown by western European industry to date. ESA

N92-24506# MATRA Espace, Toulouse (France).
AUTONOMOUS AND ADVANCED GNC TECHNIQUES FOR THE INTERPLANETARY ROSETTA MISSION
C. Champetier, J. Serrano, and J. deLafontaine (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 559-570 (For primary document see N92-24432 15-18)
(Contract ESA-8808/90/NL/PM)
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The results obtained in the frame of the ESA study on 'Autonomous Advanced Navigation Techniques', part of the Technology and Research Program of ESA, are presented. Guidance, Navigation and Control (GNC) concepts applicable to the near comet phases of the Rosetta mission are investigated and preliminary performance results described. The main points discussed concern: the attitude and articulation control system design for a multibody spacecraft; the elaboration of autonomous GNC concepts for the observation phase of the mission, including the investigation of collision detection and avoidance of debris; the investigation of new GNC concepts applicable to an autonomous landing on a comet; the control of the spacecraft dynamics at touch down. Recommendations and additional work to be performed are discussed. ESA

N92-24507# Alenia Spazio S.p.A., Rome (Italy).
ATTITUDE CONTROL DESIGN CONCEPTS IN THE DRTM SATELLITES
L. Mazzini, A. Ritorto, and E. Astin *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 571-577 (For primary document see N92-24432 15-18)
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A description of the attitude and pointing control system developed for the Artemis spacecraft is presented. The Artemis spacecraft, the first DRTM (Data Relay Technology Mission) is a communications technology demonstration satellite to provide links to Low Earth Orbiting (LEO) vehicles and to land based data stations. The communication payloads include: an optical data relay link (SILEX) that communicates with LEO vehicles; S band multiple access payload that communicates between LEO vehicles and fixed land based data stations; L band data relay link to mobile land based terminals. These communications payloads require the spacecraft bus to provide very precise attitude control. The attitude control system requirements are described. Candidate configurations to implement the Artemis attitude control system are discussed. Trade comparisons are made between the candidate mechanizations. A detailed performance analysis and simulation for the selected control system mechanization is presented. ESA

N92-24508# MATRA Espace, Paris-Velizy (France). Automatic Studies.
CONTROL OF LARGE EARTH OBSERVATION SPACECRAFTS FROM SPOT1 TO PPF1
B. Polle *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 579-584 (For primary document see N92-24432 15-18)
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From SPOT 1 to the last generation of PPF-1 (Polar Platform), the control algorithms have been reviewed to cope with new configurations. Various schemes of controllers and modulators have been designed to improve the performance, from the simple PD controller to a reduced order LQG taking into account the varying configuration of the solar array. In fine control mode, the required high rate stability is perturbed by the solar array mechanism rotation irregularities. As this perturbation was demonstrated to be uncontrollable using the wheels on the central body, a close loop control of the mechanism was implemented. Higher controller complexity, high coupling between axes introduced by the solar array configuration and very low damping of SPOT 4 solar arrays all imply that an adaptation is needed of the analysis tools from classical to modern control. In thruster control modes, (mainly in orbit control mode) some specific problems were analyzed resulting from the fact that the control is no more collocated as is the case in fine mode. Some of the thrusters were therefore unstable with respect to the similar array flexibility when using a simple PD controller. Thruster control of a flexible structure has to be carefully analyzed since each thruster has its own transfer function on the flexible modes. An LQG reduced order controller was designed to cope with the actual thruster configuration on SPOT 4. ESA

N92-24509# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ON THE DYNAMICS AND CONTROL OF THE FIRST BRAZILIAN REMOTE SENSING SATELLITE
I. MilagredaFonesca and J. F. Ribeiro *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 585-588 (For primary document see N92-24432 15-18)
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A summary of the Brazilian remote sensing mission, the mathematical model of the first Brazilian remote sensing satellite and the attitude dynamics analysis, taking into account the active control performed by a reaction wheel, jet gas and magnetic coil, is presented. The main objectives are to test the control law and to analyze the interaction between the control system and the elastic motion of the satellite solar arrays. The equations of motion were derived by the Lagrangian approach for quasi coordinates (rotational motion) and for generalized coordinates (elastic motion). The attitude equations were written in terms of quaternion. The gravity gradient torque was also considered. The results show that the control works well and that no significant interaction between the control system and the elastic motion of the solar arrays exists. ESA

N92-24510# British Aerospace Public Ltd. Co., Stevenage (England). Earth Observation and Science Div.
THE DYNAMICS OF THE CLUSTER SPACECRAFT
C. A. Stephenson *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 589-594 (For primary document see N92-24432 15-18)
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Although the cluster spacecraft is basically a simple, highly stable spinner, its dynamics and its AOCMS (Attitude and Orbit Control and Maneuver System) posses a number of unusable and interesting features. The spacecraft contains large quantities of liquid propellant and, in orbit, deploys eight booms. Four of these booms are cable booms, each 50 m in length. The spacecraft is maneuvered extensively in the deployed configuration and the response of the deployed spacecraft to maneuvering are discussed, together with the analytical tools and software packages used to support the investigations. ESA

N92-24511# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
STAR TRACKERS AND SUN SENSORS FOR A MODERN ATTITUDE CONTROL SYSTEM **c19**
S. Thuerey, U. Schmidt, and G. Kulterer (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, Germany, F.R.) *In its* Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 597-600 (For primary document see N92-24432 15-18)
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For enhanced accuracy requirements and for autonomous spacecraft operations a family of attitude sensors was developed, consisting of a Sun sensor assembly and a star tracker system. Both types of sensors are based on a common electronic design, and provide for internal data evaluation and real time or offline self test features. The interface to the AOCS (Attitude and Orbit Control System) is established via serial bus electronics and the sensors are easily adaptable to different mission types. ESA

N92-24512# Mitsubishi Electric Corp., Amagasaki (Japan). Central Research Lab.
DEVELOPMENT OF A HYBRID DOCKING DYNAMICS SIMULATOR **c14**
Masao Inoue, Jun Nakagawa, and Naomi Arima (Mitsubishi Electric Corp., Kamakura, Japan) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 601-606 (For primary document see N92-24432 15-18)
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In order to evaluate the performances of automatic rendezvous and docking system, a hybrid motion simulator was developed. The relative motion of the spacecraft after collision was realized in real time by a computer controlled moving table in which real docking hardwares were exposed to the target. The mechanical configuration, computer architecture and the simulation algorithms are described. To make the system reliable, a dual Digital Signal Processing (DSP) card and delay compensation are introduced. Several docking tests prove the simulator to be a powerful tool for designing docking systems. ESA

N92-24513# Ball Corp., Boulder, CO. Electro-Optical Sensors Dept.
A NEW GENERATION STELLAR ATTITUDE SENSOR: THE CT-601 SOLID-STATE STAR TRACKER **c19**
J. P. McQuerry, D. D. Wagner, M. L. Sullivan, R. A. Deters, and M. A. Radovich *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 607-611 (For primary document see N92-24432 15-18)
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Advanced spacecraft now in development require increased attitude control capability. In many cases, only stellar sensors can furnish the high accuracy necessitated by high performance payloads. As attitude control systems become more capable, it is necessary to provide improved accuracy, flexibility, and operability in startrackers. A new generation solid state startracker, the Model CT-601, that meets today's needs for extremely high accuracy stellar sensing, and incorporates extensive programmability so that operation can be tailored to mission requirements, is described. The CT-601 is now available for a wide variety of programs. ESA

N92-24573# Lawrence Livermore National Lab., CA.
SPECKLE IMAGING OF SATELLITES
J. P. Fitch, T. W. Lawrence, D. M. Goodman, and E. M. Johansson Dec. 1991 5 p Presented at the Signal Recovery and Synthesis Topical Meeting, New Orleans, LA, 14-16 Apr. 1992
(Contract W-7405-eng-48)
(DE92-008556; UCRL-JC-108929; CONF-920496-1) Avail: NTIS HC/MF A01

We performed a series of experiments using the Air Force Optical Station's 1.6 m telescope and a bare CCD detector to capture speckle images of various satellites. The speckle images were processed with bispectral techniques for recovering image Fourier phase as well as projection onto convex sets for recovering image Fourier magnitude from the projected autocorrelation. Results of imaging point stars and binaries are shown as a baseline assessment of our technique. We have reconstructed high quality images of numerous satellites and will show reconstructions of a very familiar satellite: the Hubble Space Telescope. To our knowledge, this is the first demonstration of the use of bare CCD's for speckle imaging of relatively bright objects such as artificial satellites. DOE

N92-24792*# B and T Engineering, Austin, TX.
SELF-UNLOADING, REUSABLE, LUNAR LANDER PROJECT Final Design Report
Ruwan Arseculeratne, Melissa Cavazos, John Euker, Fred Ghavidel, Todd J. Hinkel, John Hitzfelder, Jesse Leitner, James Nevik, Scott Paynter, and Allen Zolondek 7 Dec. 1990 135 p Prepared for Texas Univ., Austin
(Contract NASw-4435)
(NASA-CR-189984; NAS 1.26:189984) Avail: NTIS HC/MF A07 CSCL 22B

In the early 21st century, NASA will return to the Moon and establish a permanent base. To achieve this goal safely and economically, B&T Engineering has designed an unmanned, reusable, self-unloading lunar lander. The lander is designed to deliver 15,000 kg payloads from an orbit transfer vehicle (OTV) in a low lunar polar orbit and an altitude of 200 km to any location on the lunar surface. Author

N92-24801*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STRUCTURAL PERFORMANCE OF TWO AEROBRAKE HEXAGONAL HEAT SHIELD PANEL CONCEPTS
John T. Dorsey and James W. Dyess (Virginia Polytechnic Inst. and State Univ., Blacksburg.) May 1992 32 p
(NASA-TM-4372; L-17056; NAS 1.15:4372) Avail: NTIS HC/MF A03 CSCL 22B

Structural sizing and performance are presented for two structural concepts for an aerobrake hexagonal heat shield panel. One concept features a sandwich construction with an aluminum honeycomb core and thin quasi-isotropic graphite-epoxy face sheets. The other concept features a skin-rib isogrid construction with thin quasi-isotropic graphite-epoxy skins and graphite-epoxy ribs oriented at 0, +60, and -60 degs along the panel. Linear static, linear bifurcation buckling, and nonlinear static analyses were performed to compare the structural performance of the two panel concepts and assess their feasibility for a lunar transfer vehicle aerobrake application. Author

N92-24387# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Leichtbau.
DETERMINATION OF THE STRUCTURAL WEIGHT OF SPACECRAFT [ERMITTLUNG DES STRUKTURGEWICHTES VON RAUMFLUGZEUGEN]
J. Albus *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 93-94 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24389# Gesamthochschule, Duisburg (Germany, F.R.).
MODELING AND SIMULATION OF COMPLEX MECHANICAL SYSTEMS FOR SPACE APPLICATIONS [MODELLIERUNG UND SIMULATION KOMPLEXER MECHANISCHER SYSTEME MIT ANWENDUNGEN IN DER RAUMFAHRT]
M. Hiller *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 99 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24720# CISI Ingenierie, Toulouse (France).
ANALYSIS OF SEPARATION STRATEGIES FOR CO-LOCATED SATELLITES
Luc Maisonobe and C. Dejoie *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 5-9 (For primary document see N92-24719 15-12)
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N92-24721# Satellite Operational Services G.m.b.H., Gilching (Germany, F.R.).
APPROACH TO THE EVALUATION OF INTERFERENCES BETWEEN CO-LOCATED GEOSTATIONARY SPACECRAFT
Alexander Haerting *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 11-16 (For primary document see N92-24719 15-12)
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N92-24722# Telespazio, S.p.A., Rome (Italy).
AN ECCENTRICITY CONTROL STRATEGY FOR COORDINATED STATION KEEPING
S. Carlini and F. Graziani (Rome Univ., Italy) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 17-21 (For primary document see N92-24719 15-12)
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N92-24723# Centre National d'Etudes Spatiales, Toulouse (France).
ONE YEAR OF CO-LOCATION AT 19 DEGREES WEST WITH TDF1 AND TDF2 SPACECRAFTS
Francoise Dufor *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 23-25 (For primary document see N92-24719 15-12)
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N92-24724# Mathematischer Beratungs- und Programmierungsdienst G.m.b.H., Dormund (Germany, F.R.). Software and Systems Div.
PHOTOGRAPHIC OBSERVATIONS OF THE CO-LOCATED SPACECRAFT AT 19 DEG WEST
Hermann Boehnhardt *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 27-32 (For primary document see N92-24719 15-12)
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N92-24728# Zaragoza Univ. (Spain). Grupo de Mecanica Espacial.
RELEGATION OF THE PROPER ROTATION IN ATTITUDE DYNAMICS OF A SPACECRAFT
A. Elipe, M. Arribas, and J. Palacian *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 55-59 (For primary document see N92-24719 15-12)
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N92-24734# Politecnico di Torino (Italy). Dipartimento di Automatica e Informatica.
THE ON-GROUND ATTITUDE RECONSTITUTION OF THE HIPPARCOS SATELLITE
E. Canuto and Francesco Donati *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 97-103 Prepared in cooperation with Centro di Studi sui Sistemi, Turin, Italy (For primary document see N92-24719 15-12)
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N92-24748# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.). Orbit Attitude Div.
OLYMPUS RECOVERY: ATTITUDE ASPECTS
P. deBroeck *In its* Spacecraft Flight Dynamics Dec. 1991 p 221-229 (For primary document see N92-24719 15-12)
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N92-24751# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.). Orbit Attitude Div.
ULYSSES PRINCIPAL AXIS TILT DETERMINATION AND C-LOADING
G. Gienger *In its* Spacecraft Flight Dynamics Dec. 1991 p 245-250 (For primary document see N92-24719 15-12)
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N92-24752# Science Systems Ltd., Bristol (England).
ATTITUDE ASPECTS OF THE GIOTTO EXTENDED MISSION
M. J. H. Walker *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 251-257 (For primary document see N92-24719 15-12)
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N92-24754# Science Systems Ltd., Bristol (England).
THREE-AXIS STABILISATION IN LEOP: AUTONOMY OR GROUND CONTROL?
J. H. C. Auburn *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 267-273 (For primary document see N92-24719 15-12)
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N92-24755# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.). Space Dynamics Section.
ESTIMATION OF ATTITUDE THRUSTER ACTIVITY OF SPACECRAFT ON SUN ACQUISITION MODE
O. Montenbruck and E. Gill *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 275-278 (For primary document see N92-24719 15-12)
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N92-24757# Centre National d'Etudes Spatiales, Toulouse (France).
INMARSAT-2 F1 AND F2 LAUNCH AND EARLY OPERATION PHASES ASSESSMENT OF THE IMPACT OF CONTINGENCY CASES ON ATTITUDE DETERMINATION USING IN-FLIGHT DATA
Gilles Tavernier *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 285-290 (For primary document see N92-24719 15-12)
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N92-24758# Science Systems Ltd., Bristol (England).
ITALSAT MULTIPLE APOGEE ENGINE FIRINGS
D. Hocken *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 291-295 (For primary document see N92-24719 15-12)
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N92-24759# Grupo de Mecanica del Vuelo S.A., Madrid (Spain).
AUTOMATION CONCEPTS FOR GEOSYNCHRONOUS ORBIT CONTROL: A PEPSOC BASED AUTOMATED, DECISION MAKING SUPPORT TOOL
J. Potti *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 297-303 (For primary document see N92-24719 15-12)
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N92-24761# Academia Sinica, Beijing (China). Center for Space Science and Applied Research.
SIMULATION RESULTS OF COUPLING DYNAMICS FOR SPACECRAFT WITH PANELS OF LARGE SIZE
Huai-Bao Gao *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 311-316 (For primary document see N92-24719 15-12)
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N92-24762# Academy of Sciences (USSR), Moscow. Inst. of Space Research.
MAGNETICALLY STABILIZED SATELLITE ATTITUDE MOTION AND DIFFERENTIAL EQUATIONS WITH SLOWLY CHANGING COEFFICIENTS
M. L. Pivovarov *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 317-322 (For primary document see N92-24719 15-12)
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N92-24763# Academy of Sciences (USSR), Moscow. Inst. of Applied Mathematics.
GRAVITY ORIENTATION OF LARGE SPACE STATIONS
V. A. Sarychev and V. V. Sazonov *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 323-330 (For primary document see N92-24719 15-12)
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N92-24764*# Computer Sciences Corp., Lanham, MD.
DYNAMICS MODELING FOR ERBS ATTITUDE PROPAGATION
E. Harvie and D. Chu *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 331-337 (For primary document see N92-24719 15-12)
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N92-24765# Chinese Academy of Space Technology, Beijing. Inst. of Spacecraft System Engineering.
ON DEVELOPMENT OF LARGE SPACECRAFT DYNAMICS IN CHINA
Guangji Qu, Dengyun Yu, Ruqing Xi, and Zhonggui Chen *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 339-345 (For primary document see N92-24719 15-12)
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N92-24766# Academy of Sciences (USSR), Moscow. Inst. of Applied Mathematics.
AERODYNAMIC STABILIZATION SYSTEM OF SMALL SCIENTIFIC SATELLITE
M. Y. Ovchinnikov and V. I. Penkov (Moscow Inst. of Aviation Technology, USSR) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 347-353 (For primary document see N92-24719 15-12)
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N92-24767# Columbia Univ., New York, NY. Dept. of Mechanical Engineering.
NEW PROBLEMS IN SPACE FLIGHT OPERATIONS INTRODUCED BY SATELLITE MOUNTED ROBOTS
Richard W. Longman *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 357-362 (For primary document see N92-24719 15-12)
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N92-24768# Padua Univ. (Italy). Dept. of Mechanical Engineering.
FUNCTIONAL OBJECTIVES OF DYNAMICS EXPERIMENTS IN THE TSS-1 MISSION
S. Bergamaschi and A. Catinaccio *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 363-368 (For primary document see N92-24719 15-12)
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N92-24772# Padua Univ. (Italy). Dept. of Mechanical Engineering.
TETHER ASSISTED RE-ENTRY PRELIMINARY ANALYSIS FOR SEDS
S. Bergamaschi and F. Bonon *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 381-387 (For primary document see N92-24719 15-12)
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N92-24773# Tsukuba Space Center, Ibaragi (Japan). Tracking and Control Center.
SYNCHRONOUS OPERATION OF MOS-1 AND MOS-1b
T. Yoshikawa, M. Matsuura, K. Ueno, and M. Kashimoto *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 389-395 (For primary document see N92-24719 15-12)
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N92-24790# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
ERS-1 IN-FLIGHT ATTITUDE PERFORMANCE VERIFICATION
X. Marc and L. Massonne (Mathematischer Beratungs- und Programmierungsdienst G.m.b.H., Dormund, Germany, F.R.) *In its* Spacecraft Flight Dynamics Dec. 1991 p 521-528 (For primary document see N92-24719 15-12)
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N92-24807*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PRELIMINARY FINDINGS OF THE LDEF MATERIALS SPECIAL INVESTIGATION GROUP
Bland A. Stein and H. Gary Pippin (Boeing Co., Seattle, WA.) *In its* LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 617-641 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 22B

N92-25086*# Boeing Co., Huntsville, AL.
SPACE STATION FREEDOM COMMON BERTHING MECHANISM
Erik Illi *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 281-296 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 22B

N92-25087*# Sener S.A., Bilbao (Spain).
A MULTIPURPOSE MODEL OF HERMES-COLUMBUS DOCKING MECHANISM
J. J. Gonzalez-Vallejo, W. Fehse, and A. Tobias (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 297-313 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 22B

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N92-25134*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SPACE ACCELERATION MEASUREMENT SYSTEM TRIAXIAL SENSOR HEAD ERROR BUDGET
John E. Thomas, Rex B. Peters, and Brian D. Finley (Sverdrup

Technology, Inc., Brook Park, OH.) Jan. 1992 28 p (Contracts NAS3-24816; NAS3-25266) (NASA-TM-105300; E-6647; NAS 1.15:105300) Avail: NTIS HC/MF A03 CSCL 22B

The objective of the Space Acceleration Measurement System (SAMS) is to measure and record the microgravity environment for a given experiment aboard the Space Shuttle. To accomplish this, SAMS uses remote triaxial sensor heads (TSH) that can be mounted directly on or near an experiment. The errors of the TSH are reduced by calibrating it before and after each flight. The associated error budget for the calibration procedure is discussed here. Author

N92-24444*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE PRECISION SEGMENTED REFLECTORS: MODERATE MISSION FIGURE CONTROL SUBSYSTEM
G. Sevaston, D. Redding (Draper, Charles Stark Lab., Inc., Houston, TX), K. Lau, W. Breckenridge, B. Levine, N. Nerheim, S. Sirlin, and H. Kadogawa *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 89-96 Sponsored by NASA, Washington (For primary document see N92-24432 15-18)
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N92-24456# Kayser Threde G.m.b.H., Munich (Germany, F.R.).
DEVELOPMENT OF THE MAXUS-1 ARCS USING FIBRE-OPTIC GYROS
B. Eisfeller, G. Schmitt, and A. Lissner *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 173-178 (For primary document see N92-24432 15-18)
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N92-24457# Centre National d'Etudes Spatiales, Toulouse (France).
ATTITUDE MEASUREMENT AND STAR LINE OF SIGHT: FROM ON-GROUND EXPERIMENT TO FLIGHT RESULTS
O. Vandermarcq *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 179-187 (For primary document see N92-24432 15-18)
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N92-24458# Satellites International Ltd., Newbury (England).
LOW COST SPACECRAFT ATTITUDE SENSORS
M. R. Leese, A. K. Ward, S. Paice, and S. Heyhoe *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 189-194 (For primary document see N92-24432 15-18)
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N92-24459# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
AUTONOMOUS STAR IDENTIFICATION AND SPACECRAFT ATTITUDE DETERMINATION WITH CCD STAR TRACKERS
T. E. Strikwerda, H. L. Fisher, C. C. Kilgus, and L. J. Frank *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 195-200 Sponsored by Army Engineer Topographic Labs. (For primary document see N92-24432 15-18)
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N92-24482# Fairchild Space Co., Germantown, MD. Guidance, Navigation and Control Dept.
DOUBLE GIMBALLED MOMENTUM WHEEL DESIGN FOR SMALL SATELLITES
Mohammed Shamma and Theodore Michaelis *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 369-391 (For primary document see N92-24432 15-18)
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N92-24483# Teldix Luftfahrt-Ausruestungs G.m.b.H., Heidelberg (Germany, F.R.).
A DOUBLE GIMBALLED MAGNETIC BEARING MOMENTUM WHEEL FOR HIGH POINTING ACCURACY AND VIBRATION SENSITIVE SPACE APPLICATIONS
U. J. Bichler *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 393-398 (For primary document see N92-24432 15-18)
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N92-24511# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
STAR TRACKERS AND SUN SENSORS FOR A MODERN ATTITUDE CONTROL SYSTEM
S. Thuerey, U. Schmidt, and G. Kulterer (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich, Germany, F.R.) *In its* Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 597-600 (For primary document see N92-24432 15-18)
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N92-24513# Ball Corp., Boulder, CO. Electro-Optical Sensors Dept.
A NEW GENERATION STELLAR ATTITUDE SENSOR: THE CT-601 SOLID-STATE STAR TRACKER
J. P. McQuerry, D. D. Wagner, M. L. Sullivan, R. A. Deters, and M. A. Radovich *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 607-611 (For primary document see N92-24432 15-18)
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N92-24596# Swedish Inst. of Space Physics, Kiruna.
THE HOT PLASMA SPECTROMETERS ON FREJA
O. Norberg and L. Eliasson *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 41-44 (For primary document see N92-24589 15-12)
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N92-24614# Kayser Threde G.m.b.H., Munich (Germany, F.R.).
DESIGN OF A SERVICE MODULE FOR MAXUS
W. Engler and G. Schmitt *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 147-150 (For primary document see N92-24589 15-12)
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N92-24615# Kayser Threde G.m.b.H., Munich (Germany, F.R.).
RF-SYSTEM DESIGN FOR MAXUS HIGH ALTITUDE SOUNDING ROCKET PAYLOADS
H. Pfeuffer and W. Engler *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 151-154 (For primary document see N92-24589 15-12)
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N92-24616# Kayser Threde G.m.b.H., Munich (Germany, F.R.).
THE MAXUS PAYLOAD ATTITUDE AND RATE CONTROL SYSTEM UTILIZING FIBRE-OPTIC GYROS
G. Schmitt, A. Lissner, and B. Eissfeller *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 155-159 (For primary document see N92-24589 15-12)
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N92-24771# Harbin Inst. of Tech. (China). Dept. of Applied Physics.
PHOTOELECTRIC SENSOR WITH PSD
Yuan Zhao, Yong-Jiang Dai, Xi-Ping Cai, and Chun-Fei Li *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 377-379 (For primary document see N92-24719 15-12)
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N92-25078*# Ithaco, Inc., Ithaca, NY.
A COMBINED EARTH SCANNER AND MOMENTUM WHEEL FOR ATTITUDE DETERMINATION AND CONTROL OF SMALL SPACECRAFT
Bill Bialke *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 157-172 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 22B

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N92-24201*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LARGE TRANSIENT FAULT CURRENT TEST OF AN ELECTRICAL ROLL RING
Edward J. Yenni (Rockwell International Corp., Cleveland, OH.) and Arthur G. Birchenough 1992 7 p Presented at the 26th Intersociety Energy Conversion Engineering Conference, Boston, MA, 4-9 Aug. 1991; sponsored by ANS, SAE, ACS, AIAA, ASME, IEEE, and AIChE
(NASA-TM-105667; E-7029; NAS 1.15:105667) Avail: NTIS HC/MF A02 CSCL 21C

The space station uses precision rotary gimbals to provide for sun tracking of its photoelectric arrays. Electrical power, command signals and data are transferred across the gimbals by roll rings. Roll rings have been shown to be capable of highly efficient electrical transmission and long life, through tests conducted at the NASA Lewis Research Center and Honeywell's Satellite and Space Systems Division in Phoenix, AZ. Large potential fault currents inherent to the power system's DC distribution architecture, have brought about the need to evaluate the effects of large transient fault currents on roll rings. A test recently conducted at Lewis subjected a roll ring to a simulated worst case space station electrical fault. The system model used to obtain the fault profile is described, along with details of the reduced order circuit that was used to simulate the fault. Test results comparing roll ring performance before and after the fault are also presented.
Author

N92-24241*# Sunpower, Inc., Athens, OH.
OSCILLATING FLOW LOSS TEST RESULTS IN STIRLING ENGINE HEAT EXCHANGERS Final Report
G. Koester, S. Howell, G. Wood, E. Miller, and D. Gedeon (Gedeon Associates, Athens, OH.) May 1990 296 p
(Contract NAS3-24879)
(NASA-CR-182288; NAS 1.26:182288) Avail: NTIS HC/MF A13 CSCL 10B

The results are presented for a test program designed to generate a database of oscillating flow loss information that is applicable to Stirling engine heat exchangers. The tests were performed on heater/cooler tubes of various lengths and entrance/exit configurations, on stacked and sintered screen regenerators of various wire diameters and on Brunswick and Metex random fiber regenerators. The test results were performed over a range of oscillating flow parameters consistent with Stirling engine heat exchanger experience. The tests were performed on the Sunpower oscillating flow loss rig which is based on a variable stroke and variable frequency linear drive motor. In general, the results are presented by comparing the measured oscillating flow losses to the calculated flow losses. The calculated losses are based on the cycle integration of steady flow friction factors and entrance/exit loss coefficients.
Author

N92-24557*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
METALLIZED GELLED MONOPROPELLANTS
Erin G. Nieder, Charles E. Harrod, Frederick C. Rodgers, Douglas C. Rapp (Sverdrup Technology, Inc., Brook Park, OH.), and Bryan A. Palaszewski Apr. 1992 22 p
(Contracts NAS3-25831; NAS3-25266)
(NASA-TM-105418; E-6829; NAS 1.15:105418) Avail: NTIS HC/MF A03 CSCL 21I

Thermochemical calculations of seven metallized monopropellants were conducted to quantify theoretical specific impulse and density specific impulse performance. On the basis of theoretical performance, commercial availability of formulation constituents, and anticipated viscometric behavior, two metallized monopropellants were selected for formulation characterization: triethylene glycol dinitrate, ammonium perchlorate, aluminum and hydrogen peroxide, aluminum. Formulation goals were established, and monopropellant formulation compatibility and hazard sensitivity were experimentally determined. These experimental results indicate that the friction sensitivity, detonation susceptibility, and material handling difficulties of the elevated monopropellant formulations and their constituents pose formidable barriers to their future application as metallized monopropellants.
Author

N92-24560*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ADVANCED LIQUID ROCKETS
Steven J. Schneider 1992 16 p Presented at the JANNAF Propulsion Meeting, Indianapolis, IN, 24-27 Feb. 1992
(NASA-TM-105633; E-6976; NAS 1.15:105633) Avail: NTIS HC/MF A03 CSCL 21H

A program to substitute iridium coated rhenium for silicide coated niobium in thrust chamber fabrications is reviewed. The life limiting phenomena in each of these material systems is also reviewed. Coating cracking and spalling is not a problem with iridium-coated rhenium as in silicide-coated niobium. Use of the new material system enables an 800 K increase in thruster operating temperature from around 1700 K for niobium to 2500 K for rhenium. Specific impulse iridium-coated rhenium rockets is nominally 20 seconds higher than comparable niobium rockets in the 22 N class and nominally 10 seconds higher in the 440 N class.
Author

N92-24665*# Rockwell International Corp., Huntsville, AL. Space Transportation Systems Div.
ADVANCED NSTS PROPULSION SYSTEM VERIFICATION STUDY Final Report
Charles Wood 31 Jul. 1989 276 p
(Contract NAS8-36700)
(NASA-CR-184306; NAS 1.26:184306) Avail: NTIS HC/MF A13 CSCL 21H

The merits of propulsion system development testing are discussed. The existing data base of technical reports and specialists is utilized in this investigation. The study encompassed a review of all available test reports of propulsion system development testing for the Saturn stages, the Titan stages, and the Space Shuttle main propulsion system. The knowledge on propulsion system development and system testing available from specialists and managers was also 'tapped' for inclusion.
D.R.D.

N92-24957*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DEVELOPMENT OF ADVANCED SEALS FOR SPACE PROPULSION TURBOMACHINERY
R. C. Hendricks, A. D. Liang, D. W. Childs (Texas A&M Univ., College Station.), and M. P. Proctor Apr. 1992 15 p Presented at the 1992 Aerospace Atlantic International Conference and Exposition, Dayton, OH, 6-10 Apr. 1992; sponsored by the Society of Automatic Engineers
(NASA-TM-105659; E-7024; NAS 1.15:105659) Avail: NTIS HC/MF A03 CSCL 21H

Current activities in seals for space propulsion turbomachinery that the NASA Lewis Research Center sponsors are surveyed. The overall objective is to provide the designer and researcher

with the concepts and the data to control seal dynamics and leakage. Included in the program are low-leakage seals, such as the brush seal, the 'ceramic rope' seal, low-leakage seals for liquid oxygen turbopumps, face seals for two phase flow, and swirl brakes for stability. Two major efforts are summarized: a seal dynamics in rotating machinery and an effort in seal code development. Author

N92-24469# Aerospatiale, Les Mureaux (France). Div. of Space and Strategic Systems.
OBJECTIVE PROPELLANT CONSUMPTION AND THRUSTERS ACTIVATIONS FOR THE ATTITUDE CONTROL OF THE HERMES-COLUMBUS COMPOSITE
C. Billant-Guillaumin, J. Magne, and J. M. Seguin *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 271-276 (For primary document see N92-24432 15-18)
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N92-24628# Swedish Space Corp., Kiruna.
NEW TECHNIQUES USED FOR HIGH ALTITUDE SOUNDING ROCKETS AT ESRANGE (SWEDEN)
L. Marcus *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 229-230 (For primary document see N92-24589 15-12)
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N92-24633# Saab-Space A.B., Linkoeping (Sweden).
THE SPINRAC SYSTEM: CONTROL OF EXOATMOSPHERIC VEHICLES
L. Hall and A. Helmersson *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 251-255 (For primary document see N92-24589 15-12)
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N92-24636# British Aerospace Public Ltd. Co., Bristol (England). Earth Observation and Science Div.
THE SKYLARK SOUNDING ROCKET PAST AND FUTURE PROJECTS
J. A. Ellis *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 269-272 (For primary document see N92-24589 15-12)
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N92-24756# Tsukuba Space Center, Ibaragi (Japan).
OPERATIONAL STRATEGIES FOR LIQUID APOGEE PROPULSION SYSTEM
M. Hirota, Mikio Sawabe, Hiruko Aoki, and T. Shimizu (Fujitsu Ltd., Tokyo, Japan) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 279-284 (For primary document see N92-24719 15-12)
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23 CHEMISTRY AND MATERIALS (GENERAL)

No abstracts in this category.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.
For ceramic materials see *27 Nonmetallic Materials.*

N92-24291# Oak Ridge National Lab., TN.
WEAR MODE TRANSITION IN A SILICON NITRIDE-SILICON CARBIDE WHISKER COMPOSITE
C. S. Yust 1991 9 p Presented at the Automotive Technology Development Contractors' Coordination Meeting, Dearborn, MI, 22-25 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE92-008259; CONF-911050-5) Avail: NTIS HC/MF A02

The mild-to-severe-wear-mode transition and the effect of cyclic contact stress on this transition are significant for tribological applications of ceramics. An extension of a previously developed wear-mode-transition diagram is proposed as a technique for portraying the long-term transition behavior of ceramics subject to cyclic contact stress. Data are presented for mineral-oil-lubricated sliding of silicon nitride on a silicon carbide whisker-reinforced silicon nitride composite which show the initiation of a transition from mild to severe wear after cyclic contact stress exposure. Data are also presented that compare the transition from mild to severe wear after cyclic contact stress exposure. Data are also presented that compare the transition behavior in mineral oil to that in a fully formulated synthetic lubricant. The three-dimensional form of the wear-mode-transition diagram provides a useful overview of the response of a ceramic to variations in velocity, load and time of exposure to cyclic contact stress. DOE

N92-25020# Cornell Univ., Ithaca, NY. Dept. of Materials Science and Engineering.
STRONG FIBERS
Che-Yu Li Mar. 1991 30 p
(Contract DE-FG02-87ER-45321)
(DE92-008240; DOE/ER-45321/T1) Avail: NTIS HC/MF A03

This program was directed to a new and generic approach to the development of new materials with novel and interesting properties, and to the precision fabrication of these materials in one and two-dimensional forms. Advanced deposition processes and microfabrication technology were used to produce fibers and grids of metals, semiconductors, ceramics, and mixtures of controlled composition and structure, and with new and interesting mechanical and physical properties. Deposition processes included the following: electron beam evaporation, co-deposition of mixtures by dual electron beam evaporation, thermal evaporation, sputtering of a single element or compound, sputtering of a single element in a gaseous atmosphere to produce compounds, plasma enhanced chemical vapor deposition (PECVD), low pressure chemical vapor deposition (LPCVD), and selective tungsten chemical vapor deposition (W-CVD). The approach was to use the deposition processes in coordination with patterns generated by optical lithography to produce fibers with transverse dimensions in the micron range, and lengths from less than a millimeter to several centimeters. The approach is also applicable to the production of two-dimensional grids and particulates of controlled sizes and geometries. DOE

N92-25119# Sandia National Labs., Albuquerque, NM.
ARC-JET TESTS OF COATED CARBON-CARBON MATERIALS
R. E. Sheldahl, G. F. Wright, Jr., and W. L. Love 1991 22 p Presented at the 38th International Instrumentation Symposium, Las Vegas, NV, 26-30 Apr. 1992
(Contract DE-AC04-76DP-00789)
(DE92-008525; SAND-91-2361C; CONF-920460-2) Avail: NTIS HC/MF A03

The use of coatings on carbon-carbon materials to reduce the oxidation of carbon is of interest for the production of nonablative aerospace structures. The arc-jet ground test facility can produce the high energy oxidizing environment necessary to simulate hypersonic flight in which to test candidate coatings. The test conditions usually required are characterized by material temperature and length of time the material remains at that

temperature. Material specimens were exposed to high energy supersonic air exhausting from the NASA Ames' 20 MW arc-jet facility. The carbon-carbon materials were heated to required temperatures with arc-heated air for specified lengths of time. This report describes the test methodology and observations of those tests. DOE

N92-25135*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A PROCEDURE FOR UTILIZATION OF A DAMAGE-DEPENDENT CONSTITUTIVE MODEL FOR LAMINATED COMPOSITES
David C. Lo, David H. Allen (Texas A&M Univ., College Station.), and Charles E. Harris Feb. 1992 32 p
(NASA-TM-104219; NAS 1.15:104219) Avail: NTIS HC/MF A03 CSCL 11D

Described here is the procedure for utilizing a damage constitutive model to predict progressive damage growth in laminated composites. In this model, the effects of the internal damage are represented by strain-like second order tensorial damage variables and enter the analysis through damage dependent ply level and laminate level constitutive equations. The growth of matrix cracks due to fatigue loading is predicted by an experimentally based damage evolutionary relationship. This model is incorporated into a computer code called FLAMSTR. This code is capable of predicting the constitutive response and matrix crack damage accumulation in fatigue loaded laminated composites. The structure and usage of FLAMSTR are presented along with sample input and output files to assist the code user. As an example problem, an analysis of crossply laminates subjected to two stage fatigue loading was conducted and the resulting damage accumulation and stress redistribution were examined to determine the effect of variations in fatigue load amplitude applied during the first stage of the load history. It was found that the model predicts a significant loading history effect on damage evolution. Author

N92-24391# Ruhr Univ., Bochum (Germany, F.R.). Lehrstuhl Werkstoffwissenschaft.
DEVELOPMENT OF A CLAW ELEMENT MODE OF SHAPE MEMORY COMPOSITES [ENTWICKLUNG EINES GREIFELEMENTES AUS FORMGEDAECHTNIS-VERBUNDWERKSTOFF]
E. Hornbogen *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 103-104 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24835*# Aerospace Corp., El Segundo, CA.
M0003-10: LDEF ADVANCED COMPOSITES EXPERIMENT
Gary L. Steckel and Tuyen D. Le *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1041-1053 (For primary document see N92-24806 15-99)
(Contract F04701-88-C-0089)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

N92-24836*# Lockheed Missiles and Space Co., Sunnyvale, CA.
LDEF-SPACE ENVIRONMENTAL EFFECTS ON MATERIALS: COMPOSITES AND SILICONE COATINGS Abstract Only
Brian C. Petrie *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1055 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

N92-24837*# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
PRELIMINARY RESULTS FROM THE LDEF/UTIAS COMPOSITE MATERIALS EXPERIMENT
R. C. Tennyson, G. E. Mabson, W. D. Morison, and J. Kleiman *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1057-1072 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

N92-24840*# Boeing Co., Seattle, WA. Defense and Space Group.
RESULTS FROM ANALYSIS OF BOEING COMPOSITE SPECIMENS FLOWN ON LDEF EXPERIMENT M0003
Pete E. George and Sylvester G. Hill *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1115-1141 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

N92-24841*# Michigan Univ., Ann Arbor.
HIGH-TOUGHNESS GRAPHITE/EPOXY COMPOSITE MATERIAL EXPERIMENT
David K. Felbeck *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1143-1147 (For primary document see N92-24806 15-99)
(Contract NAS1-17008)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

N92-24844*# MATRA Espace, Toulouse (France).
EFFECT OF SPACE EXPOSURE OF SOME EPOXY MATRIX COMPOSITES ON THEIR THERMAL EXPANSION AND MECHANICAL PROPERTIES (A0138-8)
Heinrich Jabs *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1175-1186 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N92-24292# California Univ., Berkeley. Lawrence Berkeley Lab.
THE APPLICATION OF THE SYMMETRY PROPERTIES OF OPTICAL SECOND HARMONIC GENERATION TO STUDIES OF INTERFACES AND GASES Ph.D. Thesis
M. B. Feller Nov. 1991 159 p
(Contract DE-AC03-76SF-00098)
(DE92-008286; LBL-31577) Avail: NTIS HC/MF A08

Optical second harmonic generation (SHG) is a powerful tool for studying interfaces. The symmetry properties of the process allow for surface sensitivity not available with other optical methods. In this thesis, we take advantage of these symmetry properties in SHG to study a variety of interesting systems not previously studied with this technique. We show that optical SHG is an effective surface probe with a submonolayer sensitivity for media without inversion symmetry. We demonstrate the technique on a gallium arsenide surface, exploiting the different symmetry properties of the bulk and surface of the crystal to isolate the surface contribution. We also demonstrate that optical SHG can be used to determine the anisotropic orientational distribution of a surface monolayer of molecules. We apply the technique to study homogeneously aligned liquid crystal cells. To further explore the LC-polymer interface, we used SHG to study the surface memory effect. The surface memory effect is the rendering of an isotropic interface anisotropic by putting it in contact with an anisotropic bulk. Last, we describe some preliminary measurements of a time-resolved spectroscopic study of the phenomenon of second

harmonic generation in a gas. The construction of a 500 microjoule pulsed, tunable laser source is described. DOE

N92-24294# California Univ., Berkeley. Lawrence Berkeley Lab.
CONVERSION OF ETHANE AND OF PROPANE TO HIGHER OLEFIN HYDROCARBONS
H. Heinemann and G. A. Somorjai Dec. 1991 16 p
(Contract DE-AC03-76SF-00098)
(DE92-008296; LBL-31527) Avail: NTIS HC/MF A03

Initial work on this project has shown that it is possible to convert ethane and propane in the presence of steam and oxygen over a catalyst comprising calcium-nickel-potassium oxide to both lower and higher hydrocarbons at temperatures in the range of 300-600 C. Major amounts of CO2 are formed at the higher temperatures and conversions are relatively low at the lower temperatures. However, there are indications that the objective of preparing C6 to C12 olefins may be achieved by operating at intermediate temperatures and much higher space velocities than have thus far been used. It is proposed to do a systematic investigation making blank runs to distinguish between thermal and catalytic reactions and investigating modified catalysts such as calcium cobalt potassium oxide, calcium nickel sodium oxide, magnesium nickel potassium oxide, and others. A wide variety of operating conditions will be investigated. The catalytic reaction mechanism and the role of carbon on the catalyst will be investigated by experiments with carbon and oxygen isotopes. DOE

N92-24577# Wyoming Univ., Laramie. Dept. of Chemistry.
SOLID-SURFACE LUMINESCENCE ANALYSIS
R. J. Hurtubise 1991 13 p
(Contract DE-FG02-86ER-13547)
(DE92-007740; DOE/ER-13547/3) Avail: NTIS HC/MF A03

We have characterized several interactions that are very important in solid-matrix luminescence. With silica gel chromatoplates and filter paper, simple equations were derived for calculating the individual contributions to the percent decrease in luminescence due to either moisture or to a quenching gas. For sodium acetate as a solid matrix and p-aminobenzoate as a model compound, it was concluded that p-aminobenzoate was incorporated into the crystal structure of sodium acetate, and the triplet energy was lost by skeletal vibrations in sodium acetate. Also, with the same system it was shown that p-aminobenzoate did not undergo rotational relaxation; thus, rotational processes did not contribute to the deactivation of the triplet state. Several results were obtained from model compounds adsorbed on filter paper under different temperature and humidity conditions and with a variety of heavy atoms present. Fundamental photophysical equations were used in calculating several basic parameters that revealed information on rate processes and how the absorbed energy was distributed in an adsorbed lumiphor. The most important advancement with filter paper was the development of equations that relate phosphorescence parameters of adsorbed phosphors to the Young's modulus of filter paper. These equations are based on a fundamental theory that relates the hydrogen-bonding network of paper to the modulus of paper. DOE

N92-24578# Oak Ridge National Lab., TN.
STRUCTURAL EVOLUTION AND TRANSITION OF A THREE COMPONENT DENSE MICROEMULSION SYSTEM
E. Y. Sheu, M. M. DeTar, D. A. Storm, M. Kotlarchyk (Rochester Inst. of Tech., NY.), J. S. Lin, and M. Capel 1991 11 p Presented at the NATO Advanced Study Institute Conference, Acquafredda di Maratea, Italy, 11-21 Jun. 1991
(Contract DE-AC05-84OR-21400)
(DE92-007830; CONF-9106180-3) Avail: NTIS HC/MF A03

AOT/water/decane dense microemulsions (AOT+water volume fraction ranged from 0.6 to 0.95) were investigated using various techniques including SAXS, SANS, quasielastic light scattering, dielectric relaxation, and shear viscosity, in order to study the phase behavior and the corresponding structural transition. The water to AOT molar ratio was fixed at 40.8 for the phase study, and the temperature was scanned from 3 to 65 C. Three distinct structural domains were observed in this volume fraction region. The first domain consisted of microemulsion droplets with correlation length scales describable by the Taubner-Strey Theory. The second domain was a L(sub alpha) lamellar phase and the third domain was a narrow region near the L(sub alpha) phase, identified as the L(sub 3) phase, consisting of randomly connected lamellar sheets. The lamellar structure was analyzed using a paracrystal model to extract structural parameters. The L(sub 3) phase found in this system forms at a temperature below the L(sub alpha) phase. This distinguishes it from that observed in nonionic surfactant/water/oil systems, which form the L(sub 3) phase at temperatures above the L(sub alpha) phase. The L(sub 3) phase has been recently reported for the lower AOT+water volume fraction regime (AOT/water/decane system). It also forms below the L(sub alpha) phase, but requires a substantial amount of salt. In addition to the phase study, we also studied the physical properties of the L(sub 3) phase via dynamic light scattering, dielectric relaxation, conductivity, and rheological measurements. DOE

N92-24579# Oak Ridge National Lab., TN.
DEPENDENCE OF ACTINIDE SOLID STATE CHEMISTRY AND PHYSICS ON THE CHANGING ROLE OF THE 5f-ELECTRONS
R. G. Haire 1992 9 p Presented at the 4th International Symposium on Advanced Nuclear Research, Mito City, Japan, 1-8 Feb. 1992
(Contract DE-AC05-84OR-21400)
(DE92-007839; CONF-920264-1) Avail: NTIS HC/MF A02

It is well established that the chemistry, physics, and material science of the actinides do not reflect perfectly a series of elements with a regular increase in the number of localized f-electrons (f-orbital occupation). This situation results from the hanging role of the 5f-electrons across the series. Therefore, a full understanding of the properties of the individual elements necessitates an understanding of the series as a whole. The changing influence of the f-electrons is reflected in many of the actinide's properties. Systematic comparisons of selected high-temperature and high-pressure behaviors of actinide materials are discussed to demonstrate the variable nature and roles of the f-electrons, as well as their susceptibility to experimental parameters. DOE

N92-25038# Lawrence Livermore National Lab., CA.
COMPUTER MODELING OF A TWO-STAGE FLAME
C. K. Westbrook, W. J. Pitz, C. Corre, and F. L. Dryer (Princeton Univ., NJ.) Aug. 1991 8 p Presented at the 4th International Symposium on Computational Fluid Dynamics, Davis, CA, 9-12 Sep. 1991
(Contract W-7405-eng-48)
(DE92-009119; UCRL-JC-108180; CONF-9109257-3) Avail: NTIS HC/MF A02

The structure of a very rich n-butane/oxygen/nitrogen laminar premixed flame is computed, using a numerical model and a detailed chemical kinetic reaction mechanism. The flame includes two independent fronts, the first of which is characterized by a conversion of fuel to stable intermediate species, and the second of which is characterized by production of final species and heat release. Conventional numerical techniques for flame front resolution were not applicable to this problem, and a pragmatic solution to multiple front resolution became necessary. With this simplified approach, the fundamental chemical processes taking place in and controlling the flame were successfully elucidated. However, this problem illustrates the need for a more general solutions technique to address problems with multiple fronts. DOE

N92-25051# Princeton Univ., NJ. Dept. of Mechanical and Aerospace Engineering.
EFFECT OF O2 CONCENTRATION ON MOIST CO OXIDATION
J. F. Roesler, R. A. Yetter, and F. L. Dryer 1991 5 p Presented at the Eastern Section of the Combustion Institute Fall Technical Meeting: Chemical and Physical Processes in Combustion, Ithaca,

NY, 14-16 Oct. 1991
(Contract DE-FG02-86ER-13503)
(DE92-008741; CONF-911099-1) Avail: NTIS HC/MF A01

Over the temperature range of 1000-1200 K at one atmosphere pressure, the dependency of moist CO oxidation on excess oxygen concentration changes from one of inhibition below approximately 1040 K to one of acceleration above this temperature. These newly observed characteristics of moist CO oxidation will be important factors to consider in controlling CO emissions from practical devices. DOE

N92-25063# Sandia National Labs., Albuquerque, NM.
CONTROL OF PHOTOLUMINESCENCE FROM POROUS SILICON
J. C. Barbour, D. Dimos, T. R. Guilinger, and M. J. Kelly 1991 3 p Presented at the 1992 Workshop on Atoms and Clusters, Atami, Japan, 8-10 Jan. 1992
(Contract DE-AC04-76DP-00789)
(DE92-008020; SAND-91-2878C; CONF-920188-1) Avail: NTIS HC/MF A01

Visible light emission from silicon has until recently been thought to be negligible. Although hydrogenated amorphous Si and polysilane based alloys had been known to emit light, crystalline Si has an indirect bandgap which allows only for phonon-assisted radiative bandgap-transitions which are highly inefficient and produce light outside the visible range (approx. 400 to 800 nm). Current work on porous Si and thin films of Si microcrystallites (2 to 5 nm diameter) have demonstrated photoluminescence (PL) from infrared to green. In order to make this new physical phenomenon compatible with conventional integrated circuit technology, a method is needed to control and pattern light emitting regions of this Si-based material. This paper demonstrates the use of ion irradiation to controllably reduce the emission of red light from porous silicon. In addition, the behavior of the PL intensity at room temperature as a function of incident-light energy and intensity is examined. Finally, the effects on PL of annealing treatments to recover ion-beam change is discussed. DOE

N92-24809*# Phillips Lab., Kirkland AFB, NM.
EFFECTS OF SPACE ENVIRONMENT ON STRUCTURAL MATERIALS
C. Miglionico, C. Stein, R. Roybal, R. Robertson, L. E. Murr, S. Quinones, J. Rivas, B. Marquez, A. H. Advani, and W. W. Fisher (Texas Univ., El Paso.) et al *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 663-677 (For primary document see N92-24806 15-99)
(Grant NAG9-481)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 07D

N92-24838*# Aerospace Corp., El Segundo, CA.
LONG DURATION EXPOSURE FACILITY EXPERIMENT M0003: DEINTEGRATION/FINDINGS AND IMPACTS
M. J. Meshishnek, S. R. Gyetvay, and C. H. Jaggers *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1073-1107 Sponsored in part by Strategic Defense Initiative Organization and Wright Lab. (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 07D

N92-24839*# Boeing Co., Seattle, WA. Defense and Space Group.
SURVEY OF RESULTS FROM THE BOEING MODULES ON THE M0003 EXPERIMENT ON LDEF
H. Gary Pippin, Owen Mulkey, Juris Verzemnieks, Emmett Miller, Sylvester Hill, and Harry Dursch *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1109-1113 Sponsored in part by Wright Lab. (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 07D

N92-25012 Osaka Univ., Suita (Japan). Dept. of Applied Physics.
MEASUREMENTS OF THE OPTICAL CONSTANTS OF SOME NEAR-MILLIMETER WAVE MATERIALS BY MEANS OF NON-DISPERSIVE FOURIER TRANSFORM SPECTROSCOPY
K. Sakai, T. Nakano, Y. Ichioka, and H. Matsuo (Nagoya Univ., Japan) *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 18 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

N92-25015 Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).
POWER ABSORPTION COEFFICIENT OF REXOLITE IN THE MILLIMETRE AND SUBMILLIMETRE WAVELENGTH REGION
W. Richter *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 4 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

N92-25096*# Clemson Univ., SC. Dept. of Ceramic Engineering.
AN ACETATE PRECURSOR PROCESS FOR BSCCO (2223) THIN FILMS AND COPRECIPITATED POWDERS
Gene H. Haertling *In its* Superconductivity Devices: Commercial Use of Space 5 May 1992 21 p (For primary document see N92-25094 15-33)
Avail: NTIS HC/MF A04 CSCL 09C

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N92-24210# Brookhaven National Lab., Upton, NY.
APPLICATION OF THE RAPID THERMAL PROCESS: SINTERING THE SPUTTERED ALUMINUM/SILICON CONTACT IN SILICON DETECTOR FABRICATION
Wei Chen, Zheng Li, and H. W. Kraner Nov. 1991 5 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract DE-AC02-76CH-00016)
(DE92-007594; BNL-46100; CONF-911106-76) Avail: NTIS HC/MF A01

Rapid thermal process (RTP) sintering was used in p(sup +)-n junction detector fabrication. For the same thickness of aluminum film and at the same RTP sintering condition, the leakage current of the p(sup +)-n junction detector with sputtered Al gate showed at least a 50 percent improvement and no spiking phenomena were observed. RTP sintering in 4 percent H2/N2 ambient passivates the defects introduced by sputtering and the damage caused by the (60)Co irradiation. DOE

N92-24269# Westinghouse Hanford Co., Richland, WA.
COMPARISON OF FRACTURE BEHAVIOR FOR LOW-SWELLING FERRITIC AND AUSTENITIC ALLOYS IRRADIATED IN THE FAST FLUX TEST FACILITY (FFTF) TO 180 DPA
F. H. Huang Feb. 1992 41 p Revised
(Contract DE-AC06-87RL-10930)
(DE92-008367; WHC-SA-1392-Rev-1) Avail: NTIS HC/MF A03

Fracture toughness testing was conducted to investigate the radiation embrittlement of high nickel superalloys, modified austenitic steels and ferritic steels. These materials have been experimentally proven to possess excellent resistance to void swelling after high neutron exposures. In addition to swelling resistance, post-irradiation fracture resistance is another important criterion for reactor material selection. By means of fracture

mechanics techniques the fracture behavior of those highly irradiated alloys was characterized in terms of irradiation and test conditions. Precipitation strengthened alloys failed by channel fracture with very low post-irradiation ductility. The fracture toughness of titanium modified austenitic stainless steel D9 deteriorates with increasing fluence to about 100 displacement per atom (dpa), the fluence level at which brittle fracture appears to occur. Ferritic steels such as HT9 are the most promising candidate materials for fast and fusion reactor applications. The upper-shelf fracture toughness of alloy HT9 remained adequate after irradiation to 180 dpa although its ductile-brittle transition temperature (DBTT) shift by low temperature irradiation rendered the material susceptible to brittle fracture at room temperature. Understanding the fracture characteristics under various irradiation and test conditions helps reduce the potential for brittle fracture by permitting appropriate measure to be taken. DOE

N92-24272# Northwestern Univ., Evanston, IL.
MECHANISMS OF TRANSFORMATION TOUGHENING
G. B. Olson Feb. 1992 8 p
(Contract DE-FG02-88ER-45365)
(DE92-008430; DOE/ER-45365/1) Avail: NTIS HC/MF A02

Modelling the thermodynamics and kinetics of isothermal martensitic transformation under stress, transformation toughening in austenitic steels, and dispersed phase transformation plasticity in low alloy steels are discussed briefly. DOE

N92-24282# Oak Ridge National Lab., TN.
MATERIALS CORROSION IN AMMONIA/SOLID HEAT PUMP WORKING MEDIA
D. F. Wilson, M. Howell, and J. H. DeVan Jan. 1992 13 p
(Contract DE-AC05-84OR-21400)
(DE92-008649; ORNL/TM-12004) Avail: NTIS HC/MF A03

Salt/ammonia complexes will undergo thermal cycles during use as working media for heat pumps. The interaction between container materials and complexes under thermal cyclic conditions was assessed to screen possible containment materials. Aluminum alloys 3003, 1100, and 6063 and carbon steel A214 were tested against possible heat pump working media SrCl2/NH3, CaBr2/NH3, and CaCl2/NH3. None of the containment materials showed susceptibility to stress corrosion cracking. While all the materials demonstrated excellent general corrosion resistance to SrCl2/NH3, only A214 displayed good general corrosion resistance to CaCl2/NH3. The complex CaBr2/NH3 was found to be subject to thermal cyclic instability and should not be used as a heat pump working medium. DOE

N92-24290# Oak Ridge National Lab., TN.
FIRST PRINCIPLES THEORY OF ALLOY PHASE STABILITY: ORDERING AND PRE-MARTENSITIC PHENOMENA IN BETA-PHASE NIAI
G. M. Stocks, W. A. Shelton, D. M. Nicholson, F. J. Pinski, B. Ginatempo (Messina Univ., Italy), and A. Barbieri 1991 23 p Presented at the NATO Advanced Research Workshop, Irsee (Germany), 23-29 Jun. 1991
(Contracts DE-AC05-84OR-21400; W-7405-eng-48; DE-AC04-76DR-00789)
(DE92-008257; CONF-9106275-5) Avail: NTIS HC/MF A03

We review, briefly, the first principles of the KKR-CPA theory of the electronic structure and energetics of alloys in which compositional disorder plays a role. We also review the first principle theories of ordering and alloy phase stability that are built on the KKR-CPA description of the disordered state. We point out a number of underlying electronic driving mechanisms of ordering and clustering that were uncovered. Specifically, we emphasize the important role that Fermi surface nesting plays in driving specific instabilities. Using a newly developed method for treating the effects of disorder in alloys that have complex lattices we present results for the ordering energies of beta phase Ni(c)Al(1-c) alloys. Finally, we show alloy 'Fermi surfaces' in beta-phase Ni(0.625)Al(0.375) that support the notion that the pre-martensitic phenomena observed in this alloy are Fermi surface driven. DOE

N92-24554*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE CYCLIC OXIDATION RESISTANCE AT 1200 C OF BETA-NIAI, FeAI, AND CoAI ALLOYS WITH SELECTED THIRD ELEMENT ADDITIONS
C. A. Barrett and R. H. Titran Apr. 1992 13 p
(NASA-TM-105620; E-5326; NAS 1.15:105620) Avail: NTIS HC/MF A03 CSCL 11F

The intermetallic compounds Beta-NiAl, FeAl, and CoAl were tested in cyclic oxidation with selected third element alloy additions. Tests in static air for 200 1-hr cycles at 1200 C indicated by specific weight change/time data and x-ray diffraction analysis that the 5 at percent alloy additions did not significantly improve the oxidation resistance over the alumina forming baseline alloys without the additions. Many of the alloy additions were actually deleterious. Ta and Nb were the only alloy additions that actually altered the nature of the oxide(s) formed and still maintained the oxidation resistance of the protective alumina scale. Author

N92-24567# Oak Ridge National Lab., TN.
FIRST PRINCIPLES CALCULATION OF RESIDUAL RESISTIVITY
D. M. Nicholson, W. H. Butler, R. H. Brown, H. Yang, and W. Swihart (Indiana Univ., Indianapolis.) 1991 8 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contracts DE-AC05-84OR-21400; DE-AC02-76CH-00016)
(DE92-007685; CONF-911202-57) Avail: NTIS HC/MF A02

The list of physical properties which are important in the design of materials and which are routinely calculated from first principles within the local density approximation to density functional theory is continually growing. We discuss the application of multiple scattering theory to the calculation of the residual resistivity of disordered alloys. Progress has been made on two fronts. First, the coherent potential approximation for the sensitivity, which sums to all orders a limited set of multiple scattering diagrams, has given resistivities in agreement with experiment for alloys where the site occupation is roughly random. Second, the linearized KKR was used to evaluate the Kubo formula for several large configurations of atoms and to obtain the resistivity with all multiple scattering paths included. This method is not limited to random alloys, but can be applied to short range ordered and amorphous alloys provided the resistivity is high enough to limit the mean free path to a single unit cell. DOE

N92-24581# Japan Atomic Energy Research Inst., Tokyo.
FILLER METAL DEVELOPMENT FOR HASTELLOY ALLOY XR
Katsutoshi Watanabe, Hajime Nakajima (Japan Atomic Energy Research Inst., Tokai.), and Kensho Sahira Nov. 1991 87 p
(DE92-768151; JAERI-M-91-181) Avail: NTIS HC/MF A05

The present report describes the results of cooperative research in order to evaluate the weldability and properties of Hastelloy alloy XR weldment with the filler metal fabricated on the industrial scale. A series of qualification test was performed using the filler metal, of which the content of the minor elements such as boron was optimized on the basis of the results so far obtained by the filler metal development for Hastelloy alloy XR structure with thin wall. The boron diffusion behavior, weldability, and the properties such as corrosion, aging embrittlement, and high temperature strength were examined on the Hastelloy alloy XR weldment by means of tungsten inert gas arc welding procedure. Based on the excellent weldability and weldment properties as well as the mass production possibility for the filler metal, it is concluded that the filler metals possessing the required performance has been developed. DOE

N92-24587# Maine Univ., Orono.
STRUCTURE, ADHESION, AND STABILITY OF METAL/OXIDE AND OXIDE/OXIDE INTERFACES
R. J. Lad Jan. 1992 9 p
(Contract DE-FG02-90ER-45417)
(DE92-008140; DOE/ER-45417/3) Avail: NTIS HC/MF A02

Studies of several model metal/oxide and oxide/oxide

interfaces were carried out by depositing ultra-thin metal films on single crystal oxide substrates. The specific systems that were characterized include K/TiO2, K2O/TiO2, Al/TiO2, Al2O3/TiO2, and K/NiO. The interface electronic structure and bonding interactions were determined with x-ray and UV photoelectron spectroscopies (XPS and UPS) and the structure and morphology was analyzed with low energy and high energy electron diffraction (LEED and RHEED) and atomic force microscopy (AFM). The two metal overlayers studies, K and Al, were found to strongly interact with the single crystal oxide substrates. Given adequate thermal energy, the metals became oxidized and substoichiometric TiO2 and NiO compositions were created near the interface. Defects were found to have a major influence on interface structure. The construction of the thin film deposition/RHEED analysis chamber was completed during the past year, and a versatile sample transfer and heating system was implemented. Three graduate students participated in the project, the results were presented at three national meetings, and one manuscript was submitted for publication. DOE

N92-24588# Oak Ridge National Lab., TN.
MICROSTRUCTURE, PHASE STABILITY, MECHANICAL PROPERTIES, AND SHAPE MEMORY CHARACTERISTICS OF Ni-Fe-Al-B ALLOYS
E. P. George, C. T. Liu, C. J. Sparks, J. A. Horton, Ming-yuan Kao, H. Kunsmann, and T. King 1991 8 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE92-008276; CONF-911202-62) Avail: NTIS HC/MF A02

Conventionally cast and hot-rolled Ni-Fe-Al-B alloys containing 4-20 at. percent Fe, 23.9-31.5 at. percent Al, and 300 wppm B were investigated in this study. After oil quenching from 1300 C, all the alloys (except SMA-15 (27Al-14Fe)) have a two-phase microstructure: one phase of which is martensite with the characteristic platelet morphology, and the other a globular second phase distributed throughout the microstructure. The amount of second phase generally increases with increasing Fe content. Alloys containing less than 145 Fe were found to be quite brittle at room temperature, indicating that the second phase is at least partly responsible for room-temperature ductility. The best tensile ductility (12 percent) was obtained in SMA-17 (23.9Al-20Fe) which was shown by X-ray diffraction to consist of 70 percent (mostly disordered) fcc ((Ni,Fe)3(Al,Fe)) + 25 percent (partly ordered) bct (martensite) + 5 percent B2 (NiAl). Differential scanning calorimetry showed that the transformation temperatures for this alloy were M(sub p) = 65 C and A(sub p) = 95 C. Room-temperature tensile strains of 2-3 percent could be almost completely recovered in SMA-17 by heating for 3 min. at 600 C with the load removed. Upon subsequent cycling (i.e., strain-anneal cycling), the amount of strain recovery increased dramatically from 70 percent in the first cycle to nearly 100 percent after 4-5 cycles, indicating that cold work may help in improving the shape memory characteristics of this alloy. SMA-15 was found to have significantly higher transformation temperatures (M(sub p) = 143 C and A(sub p) = 170 C) than SMA-17; however, it is relatively brittle compared to SMA-17. DOE

N92-24685# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
DEVELOPMENT OF A SPRAY-FORMING PROCESS FOR STEEL
W. DuBroff Dec. 1991 445 p Prepared in cooperation with Massachusetts Inst. of Tech., Cambridge and Oak Ridge National Lab., TN
(Contracts DE-AC07-76ID-01570; DE-FG07-89ID-12855; DE-AC05-84OR-21400)
(DE92-006773; DOE/ID-10349) Avail: NTIS HC/MF A19

Spray forming is a near-net-shape casting technology based on the atomization of a liquid spray and subsequent deposition on a substrate. The process has been shown to be suitable for a wide range of metallic and nonmetallic materials, although the focus of Phase 1 of this program was the production of plain low-carbon steel strip. Phase 1 was initiated by the Department of Energy (DOE) and a consortium of cost-sharing industrial participants in March 1989 under the Steel Initiative and consisted of three concurrent projects at the Idaho National Engineering Laboratory, Massachusetts Institute of Technology, and Oak Ridge National Laboratory. This report discusses work in Phase 1 of the project at the three sites. DOE

N92-24696# Argonne National Lab., IL.
BENEFITS OF RECYCLING GALVANIZED STEEL SCRAP FOR RECOVERY OF HIGH-QUALITY STEEL AND ZINC METAL
F. J. Dudek, E. J. Daniels, and W. A. Morgan (Metal Recovery Industries, Inc., Hamilton, Ontario) Nov. 1991 7 p Presented at the Minerals, Metals and the Environment Conference and Exhibition, Manchester, England, 4-6 Feb. 1992
(Contract W-31-109-eng-38)
(DE92-006997; ANL/CP-72296; CONF-920257-1) Avail: NTIS HC/MF A02

Argonne National Laboratory (ANL) and Metal Recovery Industries, Inc. (MRII), in cost-sharing collaboration, have developed an electrolytic process to separate and recover steel and zinc from galvanized steel scrap. This work has been supported by the US DOE. An assessment of available dezinc technology was begun in 1987 which (1) screened process concepts for separating and recovering zinc and steel from galvanized ferrous scrap, (2) selected electrochemical stripping in hot caustic as the most promising process, (3) evaluated the technical and economic feasibility of the selected process on the basis of fundamental electrochemical studies, (4) experimentally verified the technical and economic feasibility of the process in a phased evaluation from bench-scale controlled experiments through batch tests of actual scrap up to six ton lots, and (5) concluded that the process has technical and economic merit and requires larger scale evaluation in a continuous mode as the final phase of process development. This work has attracted worldwide interest. Preliminary economic analysis indicates that the cost of the recovered ferrous scrap would be about $150/ton (at a base cost of $110/ton for galvanized scrap), including credit for the co-product zinc. Concentrations of zinc, lead, cadmium and other coating constituents on loose scrap are reduced by a minimum of 98 pct., with zinc, in particular, reduced to below 0.1 pct. Removal efficiencies on baled scrap with bulk densities between 60 and 245 pounds per cubic foot range from 80 to 90 pct. About 1000 tons of galvanized scrap bales have been treated in batch operation at MRII in Hamilton, Ontario. A pilot plant for continuous treatment of 40 ton/day of loose scrap is being built by MRII in East Chicago, Indiana, with operation starting in early 1992. DOE

N92-24701# Sandia National Labs., Albuquerque, NM.
DIFFERENTIAL THERMAL ANALYSIS IN THE STUDY OF WELD METAL SOLIDIFICATION AND HOT CRACKING
M. J. Cieslak 1991 5 p Presented at the Fall Meeting of the Minerals, Metals and Materials Society of AIME and Materials Week of the American Society of Metals, Cincinnati, OH, 20-24 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE92-008681; SAND-92-0283C; CONF-911003-23) Avail: NTIS HC/MF A01

Hot cracking, or solidification cracking, is one of the most extensively studied phenomenon in welding metallurgy. The efforts made to identify the causes of this type of cracking have been driven by the negative commercial and engineering consequences resulting from the formation of these defects. Through judicious weld joint design, the mechanical restraint can be minimized, but it can never be entirely eliminated simply because metals expand and contract when heated and cooled, respectively. The localized nature of heat input in fusion welding insures a non-homogeneous thermal field being applied to the parts being welded, resulting in the development of strains in the as-solidifying weld metal. With the inherent limitations on the mechanical restraint factor, much research has gone into identifying those alloy compositions which minimize the microstructural factor required for hot cracking to occur. Examples from the author's own research are presented

as a tutorial to show how differential thermal analysis techniques have been used to study the chemical/microstructural factors associated with solidification and fusion zone hot cracking in nickel based engineering alloys. References to other uses of these techniques in related welding metallurgy studies are also given. DOE

N92-24703# Westinghouse Savannah River Co., Aiken, SC.
THE EFFECTS OF TRITIUM AND DECAY HELIUM ON THE FRACTURE TOUGHNESS PROPERTIES OF STAINLESS STEELS
M. J. Morgan 1991 9 p Presented at the 4th Topical Meeting on Tritium Technology in Fission, Fusion, and Isotopic Applications, Albuquerque, NM, 30 Sep. - 4 Oct. 1991
(Contract DE-AC09-89SR-18035)
(DE92-009828; WSRC-MS-91-159; CONF-910920-20) Avail: NTIS HC/MF A02

J-integral fracture mechanics techniques and scanning electron microscopy observations were used to investigate the effects of tritium and its decay product, helium-3, on Types 304L, 316L, 21-6-9, A286, and JBK-75 (Modified A286) stainless steels. Tritium-exposed samples of each steel had lower fracture toughness values and less resistance to stable crack growth than control samples. Type 316L stainless steel was more resistant to the embrittling effects of tritium and decay helium than the other steels. DOE

N92-25019# Lehigh Univ., Bethlehem, PA.
CORROSION FATIGUE OF IRON-CHROMIUM-NICKEL ALLOYS: FRACTURE MECHANICS, MICROSTRUCTURE, AND CHEMISTRY
R. P. Wei 29 Jan. 1992 17 p
(Contract DE-FG02-88ER-45354)
(DE92-008221; DOE/ER-45354/4) Avail: NTIS HC/MF A03

This progress report briefly summarizes the research performed under the referenced grant for the period from 1 Dec. 1990 to 31 Dec. 1991, and contains a cumulative listing of technical presentations and publications dating back to 1 Jun. 1988. Under this grant, a multi-disciplinary research program is undertaken to address certain fundamental issues relating to corrosion fatigue crack growth in structurally important alloys in aqueous environments. The principal goal of the research is to develop and expand the scientific understanding of the processes that control corrosion fatigue crack growth, particularly for ferrous alloys in terms of the controlling mechanical and chemical/electrochemical processes and their interactions with the microstructure. Focus is placed upon the austenitic iron-chromium-nickel (FeCrNi) alloys because of the need to resolve certain mechanistic issues and because of extensive utilization of these alloys in the power generation and chemical industries. Emphasis is given to the growth of short (small) cracks at low growth rates because crack growth in this regime is expected to be more sensitive to changes in external chemical/electrochemical variables. DOE

N92-25036# Johns Hopkins Univ., Baltimore, MD. Dept. of Materials Science and Engineering.
CRITICAL ISSUES IN DE-ALLOYING AND TRANSCRYSTALLINE STRESS-CORROSION CRACKING
K. Sieradzki and J. W. Wagner Mar. 1992 6 p
(Contract DE-FG02-90ER-45421)
(DE92-009086; DOE/ER-45421/2) Avail: NTIS HC/MF A02

This report describes our progress since the last reporting period (March 1991) and details the third year research plans on the program. The three major components of the program relate to: (1) kinetic aspects of the selective dissolution in alloys and the coarsening of de-alloyed layers; (2) measurements of crack dynamics during film induced cleavage processes; and (3) mechanical properties of the intrinsic de-alloyed layers responsible for film-induced cleavage events. We discuss progress in each of these areas. DOE

N92-25042# Oak Ridge National Lab., TN.
HIGH-TEMPERATURE CORROSION OF IRON ALUMINIDES
J. H. DeVan and P. F. Tortorelli 1991 7 p Presented at the NACE Annual Conference and Corrosion, Nashville, TN, 27 Apr. - 1 May 1991
(Contract DE-AC05-84OR-21400)
(DE92-008273; CONF-9104326-2) Avail: NTIS HC/MF A02

Because of their relatively high aluminum concentration, ordered alloys based on Fe3Al afford unique high-temperature oxidation properties. This paper reviews the behavior of Fe3Al-based alloys in a variety of oxidizing and sulfidizing environments that are of interest for potential service applications. The alloy is shown to afford excellent compatibility with gaseous environments consisting of air, oxygen, H2S-H2-H2O, and SO2-O2. Effects of minor alloying additions on corrosion resistance are discussed with particular reference to the role of chromium. Also reviewed are the corrosion properties of Fe3Al alloys in the presence of salt mixture composed of sulfates and nitrates, respectively. The alloy system is adversely affected by the presence of molten alkali sulfates, but it is relatively compatible with CaSO4 and molten alkali nitrates. DOE

N92-25113# Sandia National Labs., Albuquerque, NM.
HOLD TIME, STRAIN RATE, AND ENVIRONMENTAL EFFECTS ON NEAR EUTECTIC Sn-Pb UNDER CONDITIONS OF THERMOMECHANICAL FATIGUE
D. R. Frear, W. B. Jones, and N. R. Sorensen 1992 10 p Presented at the International Conference on Creep of Materials, Orlando, FL, 17-21 May 1992
(Contract DE-AC04-76DP-00789)
(DE92-008669; SAND-92-0280C; CONF-920505-4) Avail: NTIS HC/MF A02

We present results that correlate microstructure and mechanical evolution to variations of deformation rate, hold time and environmental effects on the thermomechanical fatigue (TMF) behavior of 60Sn-40Pb solder. The results are used to define valid conditions for performing accelerated TMF tests. TMF tests at deformation rates of 5.6 x 10(exp -4) s(sup -1), 2.8 x 10(exp -4) s(sup -1) and 2.1 x 10(exp -4) s(sup -1) were performed. Deformation rates greater than 2.8 x 10(exp -4) s(sup -1) result in fewer cycles to failure. At low deformation rates, the microstructure heterogeneously coarsens at cell boundaries. At higher rates, the deformation mechanism changes, and heterogeneous coarsening occurs at a strain concentration in the joint, independent of the microstructure. TMF tests with hold times of 0, 3 and 6 min. at the temperature extremes were performed. At hold times 3 min. or longer the damage at cell boundaries is annealed, resulting in heterogeneous coarsening. With no hold times the TMF life was greatly enhanced as a result of limited coarsening. The effect of the oxygen environment was explored. The TMF life in the presence of oxygen was found to be extended. Valid acceleration conditions for a TMF test of solder are: a deformation rate of 2.8 x 10(exp -4) s(sup -1) or lower, with hold times of 3 min. or longer. DOE

N92-24816*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
EFFECTS ON LDEF EXPOSED COPPER FILM AND BULK
Palmer N. Peters, John C. Gregory, Ligia C. Christl, and Ganesh N. Raikar (Alabama Univ., Huntsville.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 755-762 (For primary document see N92-24806 15-99)
(Contract NAS8-36645; NAGw-812)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11F

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N92-24568# Sandia National Labs., Albuquerque, NM.
LARGE DEFORMATION ELASTIC BEHAVIOR OF LOW-DENSITY SOLID FOAMS
W. E. Warren and A. M. Kraynik 1992 4 p Presented at the 9th Engineering Mechanics Conference of ASCE, College Station, TX, 24-27 May 1992
(Contract DE-AC04-76DP-00789)
(DE92-008670; SAND-92-0319C; CONF-9205106-1) Avail: NTIS HC/MF A01

A strain energy function that describes the nonlinear elastic response of a three-dimensional open-cell foam is developed. A tetrahedral unit cell containing four half-struts that join at equal angles represents essential features of foam microstructure. The deformation of a strut is expressed by compliances for bending and stretching, which are the primary mechanisms for small and large distortion, respectively, of a low-density foam. Higher order contributions to the strain energy are determined by assuming that the structure is effectively pin jointed. DOE

N92-24687# International Centre for Theoretical Physics, Trieste (Italy).
XPS ANALYSIS OF POLYIMIDE FILMS MODIFIED BY UV PULSED LASER RADIATION AT 192 nm
A. Brezini and N. Zekri Sep. 1991 26 p
(DE92-617498; IC-91/302) Avail: NTIS HC/MF A03

Polyimide films were treated in air with an Argon-Fluorine UV excimer laser (lambda = 193 nm). X ray photoelectron spectroscopy (XPS) analysis was performed on the modified surfaces after laser exposure at various fluences around the threshold fluence (F sub e). From the present data above F sub e the photochemical process (photoablation) leads to produce a Carbone-rich surface by ejecting mainly oxides of Carbon and Nitrogen compounds. DOE

N92-24691# Los Alamos National Lab., NM.
MODELING OF TRANSFORMATION TOUGHENING IN BRITTLE MATERIALS
R. LeSar, A. D. Rollett, and D. J. Srolovitz 24 Jan. 1992 26 p Presented at the High Temperature Structural Silicides Workshop, Gaithersburg, MD, 4-6 Nov. 1991
(Contract W-7405-eng-36)
(DE92-008444; LA-UR-92-371; CONF-9111115-5) Avail: NTIS HC/MF A03

Results from modeling of transformation toughening in brittle materials using a discrete micromechanical model are presented. The material is represented as a two-dimensional triangular array of nodes connected by elastic springs. Microstructural effects are included by varying the spring parameters for the bulk, grain boundaries, and transforming particles. Using the width of the damage zone and the effective compliance (after the initial creation of the damage zone) as measures of fracture toughness, we find that there is a strong dependence of toughness on the amount, size, and shape of the transforming particles, with the maximum toughness achieved with the higher amounts of the larger particles. DOE

N92-24715*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMPOSITION DEPENDENCE OF SUPERCONDUCTIVITY IN YBa2(Cu(3-x)Al(x))Oy
Narottam P. Bansal Dec. 1991 17 p
(NASA-TM-105358; E-6737; NAS 1.15:105358) Avail: NTIS HC/MF A03 CSCL 11C

Eleven different compositions in the system YBa2(Cu(3-x)Al(x))O(y) (x = 0 to 0.3) have been synthesized and characterized by electrical resistivity measurements, powder x-ray diffraction, and scanning electron microscopy. The superconducting transition temperature T sub c (onset) was almost unaffected by the presence of alumina due to its limited solubility in YBa2Cu3O(7-x). However, T sub c(R = 0) gradually decreased, and the resistive tails became longer with increasing Al2O3 concentration. This was probably due to formation of BaAl2O4 and other impurity phases from chemical decomposition of the superconducting phase by reaction with Al2O3. Author

N92-24894# Boston Univ., MA. Dept. of Chemistry.
CERIUM COMPOUNDS AS SCINTILLATORS
A. J. Wojtowicz, E. Berman, C. Koepke, and A. Lempicki 1991 6 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract DE-FG02-90ER-61033)
(DE92-008737; CONF-911106-83) Avail: NTIS HC/MF A02

Stoichiometric Ce-materials with negligible Ce-Ce interactions should have superior scintillator properties. We present two materials: CeF3 and Ce(x)La(1-x)P5O14. While cerium trifluoride is a known scintillator, pentaphosphate is of a limited usefulness, except as a remarkable model material. We show that quenching in fluoride is responsible for loss of 50 percent of the light output and is the cause of the, so-called, ultra fast component (2 ns). Light output of fluoride (about 50 percent of BGO) could be significantly improved. Deeper understanding of Ce-systems is needed to fully exploit their potentials. DOE

N92-24982*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
PERFORMANCE OF THERMAL CONTROL TAPE IN THE PROTECTION OF COMPOSITE MATERIALS TO SPACE ENVIRONMENTAL EXPOSURE
R. R. Kamenetzky and A. F. Whitaker Apr. 1992 15 p
(NASA-TM-103582; NAS 1.15:103582) Avail: NTIS HC/MF A03 CSCL 11C

Thermal control tape flown on the Long Duration Exposure Facility (LDEF) experiment A0171 has shown to be effective in protecting epoxy fiberglass composites from atomic oxygen and ultraviolet degradation. The tape adhesive performed well. The aluminum, however, appeared to have become embrittled by the 5.8 years of space radiation exposure. Author

N92-25027# Los Alamos National Lab., NM.
ORIGINATING SUPER-STRONG LIQUID CRYSTALLINE POLYMERS Final Report, 4 Mar. - 30 Sep. 1991
Jack Preston Nov. 1991 50 p Prepared in cooperation with Research Triangle Inst., Research Triangle Park, NC
(Contract W-7405-eng-36)
(DE92-008248; LA-SUB-92-2; RTI-4980/00-01F) Avail: NTIS HC/MF A03

Polymers were prepared in an exploratory effort that was in accordance with the design criteria for super-strong/super-stiff (SS/SS) polymers. In general, these were prepared by the synthesis of rigid rod polymers containing a pendent hydroxy group (non-reactive during the step-growth reactions) followed by attachment of a rigid rod side chain in a post polymerization reaction. One example of this type of polymer was spun to fiber. This route to the formation of SS/SS polymers is anticipated to be exceedingly useful for the future development of this class of polymer. DOE

N92-25106# Los Alamos National Lab., NM.
CORROSION-PROTECTIVE COATINGS FROM ELECTRICALLY CONDUCTING POLYMERS
K. G. Thompson, C. J. Bryan, B. C. Benicewicz, and D. A. Wrobleski 1991 12 p Presented at the Technology 2001, San Jose, CA, 3-5 Dec. 1991
(Contract W-7405-eng-36)
(DE92-008438; LA-UR-92-360; CONF-911231-6) Avail: NTIS HC/MF A03

In a joint research effort involving the Kennedy Space Center and the Los Alamos National Laboratory, electrically conductive polymer coatings have been developed as corrosion-protective coatings for metal surfaces. At the Kennedy Space Center, the

launch environment consists of marine, severe solar, and intermittent high acid/elevated temperature conditions. Electrically conductive polymer coatings have been developed which impart corrosion resistance to mild steel when exposed to saline and acidic environments. Such coatings also seem to promote corrosion resistance in areas of mild steel where scratches exist in the protective coating. Such coatings appear promising for many commercial applications. DOE

N92-25114# Battelle Columbus Labs., OH.
LONG-TERM BEHAVIOR OF CERAMIC MATERIALS
D. Anson and K. S. Ramesh 19 Feb. 1992 97 p
(Contract DE-AC02-89CE-40878)
(DE92-008749; DOE/CE-40878/T1) Avail: NTIS HC/MF A05

This topical report has been prepared in response to the need to address the question of long term durability of high-strength structural ceramic materials. In a new project to demonstrate the use of such materials as replacements for metals in the hot gas path of industrial gas turbines, the longest projected test bed run will be 1000 hours. Creep in ceramic materials seldom exceeds one percent strain before failure, but the strain takes place almost entirely in the intergranular regions, which can be severely weakened by accumulated damage as creep occurs. In this report, we discuss the nature of creep in silicon nitride and silicon carbide ceramic materials, the method of evaluating creep, and the interpretation of data obtained under various creep test conditions. A review of creep data illustrates the importance of intergranular phases and of the history of the material. Also, in most cases, the histories applying to laboratory investigations are different from those that will apply to engineering situations in which measurable creep will be generally unacceptable. Fatigue in ceramic materials usually is assessed in static fatigue tests, which are dependent on the same types of grain boundary damage as those occurring in creep, but over shorter time periods. Corrosion of silicon-based ceramics by oxygen and water vapor results in the formation of protective SiO2 under gas turbine operating conditions. DOE

N92-24811*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHEMICAL CHARACTERIZATION OF SELECTED LDEF POLYMERIC MATERIALS
Philip R. Young and Wayne S. Slemp *In its* LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 687-703 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24812*# Texas A&M Univ., College Station. Polymer Science and Engineering Program.
CHARACTERIZATION OF POLYMER FILMS RETRIEVED FROM LDEF
Alan Letton, Neil I. Rock, Kevin D. Williams, Thomas W. Strganac, and Allan Farrow *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 705-722 Sponsored in part by Rheometrics, Inc. (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24813*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MEASUREMENTS OF EROSION CHARACTERISTICS FOR METAL AND POLYMER SURFACES USING PROFILOMETRY
Ligia C. Christl, John C. Gregory (Alabama Univ., Huntsville.), and Palmer N. Peters *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 723-735 (For primary document see N92-24806 15-99)
(Contract NAS8-36645; NAGw-812)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24819*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
PRELIMINARY RESULTS FOR LDEF/HEPP THERMAL CONTROL SAMPLES
Lonny Kauder *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 797-800 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24820*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ATOMIC OXYGEN INTERACTIONS WITH FEP TEFLON AND SILICONES ON LDEF
Bruce A. Banks, Joyce A. Dever, Linda Gebauer, and Carol M. Hill (Akron Univ., OH.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 801-815 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24821*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
VACUUM ULTRAVIOLET (VUV) RADIATION-INDUCED DEGRADATION OF FLUORINATED ETHYLENE PROPYLENE (FEP) TEFLON ABOARD THE LONG DURATION EXPOSURE FACILITY (LDEF)
David E. Brinza, A. E. Stiegman, Paul R. Staszak, Eric G. Laue, and Ranty H. Liang *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 817-829 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24822*# Aerospace Corp., El Segundo, CA.
SPACE ENVIRONMENTAL EFFECTS ON SILVERED TEFLON THERMAL CONTROL SURFACES
C. S. Hemminger, W. K. Stuckey, and J. C. Uht *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 831-845 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24823*# Boeing Aerospace and Electronics Co., Seattle, WA.
RESULTS OF EXAMINATION OF SILVERED TEFLON FROM THE LONG DURATION EXPOSURE FACILITY
Ken Rousslang, E. Russ Crutcher, and H. Gary Pippin *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 847-859 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24824*# Boeing Co., Seattle, WA. Defence and Space Group.
SILVER TEFLON BLANKET: LDEF TRAY C-08
E. Russ Crutcher, L. S. Nishimura, K. J. Warner, and W. W. Wascher *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 861-874 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24825*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
PRELIMINARY INVESTIGATIONS INTO UHCRE THERMAL CONTROL MATERIALS (A0178)
Francois Levadou, Mike Froggatt, Martin Rott, and Eberhard Schneider (Ernst-Mach-Inst., Freiburg, Germany, F.R.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 875-898 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24826*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
INITIAL MATERIALS EVALUATION OF THE THERMAL CONTROL SURFACES EXPERIMENT (S0069)
Donald R. Wilkes, M. John Brown, Leigh L. Hummer (AZ Technology, Huntsville, AL.), and James M. Zwiener *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 899-917 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24827*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
UNUSUAL MATERIALS EFFECTS OBSERVED ON THE THERMAL CONTROL SURFACES EXPERIMENT (S0069)
James M. Zwiener, Kenneth A. Herren, Donald R. Wilkes, Leigh L. Hummer, and Edgar R. Miller (AZ Technology, Huntsville, AL.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 919-933 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24828*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EFFECTS OF LOW EARTH ORBIT ENVIRONMENT ON THE LONG DURATION EXPOSURE FACILITY THERMAL CONTROL COATINGS
Thomas R. Sampair (Lockheed Engineering and Sciences Co., Hampton, VA.) and William M. Berrios *In its* LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 935-944 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24829*# Centre National d'Etudes Spatiales, Toulouse (France).
SPACECRAFT THERMAL CONTROL COATINGS
Jean-Claude Guillaumon and Alain Paillous (Centre d'Etudes et de Recherches, Toulouse, France) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 945-960 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24830*# Dayton Univ. Research Inst., OH.
LONG DURATION EXPOSURE FACILITY EXPERIMENT M0003-5: THERMAL CONTROL MATERIALS
Charles J. Hurley *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 961-973 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24831*# Boeing Co., Seattle, WA. Defense and Space Group.
RESULTS OF EXAMINATION OF THE A276 WHITE AND Z306 BLACK THERMAL CONTROL PAINT DISKS FLOWN ON LDEF
Johnny L. Golden *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 975-987 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24832*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ION BEAM TEXTURED AND COATED SURFACES EXPERIMENT (IBEX)
Michael J. Mirtich, Sharon K. Rutledge, Nicholas Stevens, Raymond Olle, and James Merrow (Cleveland State Univ., OH.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 989-1004 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24833*# Army Materials Technology Lab., Watertown, MA.
ELLIPSOMETRIC STUDY OF OXIDE FILMS FORMED ON LDEF METAL SAMPLES
W. Franzen, J. S. Brodkin, L. C. Sengupta, and P. L. Sagalyn *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1005-1021 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24834*# Boeing Co., Seattle, WA. Defense and Space Group.
SPACE ENVIRONMENTAL EFFECTS ON THE INTEGRITY OF CHROMIC ACID ANODIZED COATINGS
Walter L. Plagemann *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1023-1040 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24842*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EFFECTS OF LDEF FLIGHT EXPOSURE ON SELECTED POLYMER MATRIX RESIN COMPOSITE MATERIALS
Wayne S. Slemp, Philip R. Young, William G. Witte, Jr., and James Y. Shen (Lockheed Engineering and Sciences Co., Hampton, VA.) *In its* LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1149-1162 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24843*# Aerospatiale, Les Mureaux (France). Space and Strategic Systems Div.
EFFECT OF SPACE ENVIRONMENT ON COMPOSITE MATERIALS AND THERMAL COATINGS (A0138-9)
Michel Parcelier and Jean Pierre Assie (Aerospatiale, Cannes, France) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1163-1173 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24845*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MECHANICAL PROPERTIES OF SILICATE GLASSES EXPOSED TO A LOW-EARTH ORBIT Abstract Only
David E. Wiedlocher, Dennis S. Tucker, Ron Nichols, and Donald L. Kinser (Vanderbilt Univ., Nashville, TN.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1187 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

N92-24846*# Air Force Geophysics Lab., Hanscom AFB, MA. Space Physics Div.
PATTERNS OF DISCOLORATION AND OXIDATION BY DIRECT AND SCATTERED FLUXES ON LDEF, INCLUDING OXYGEN ON SILICON
A. R. Frederickson, R. C. Filz, F. J. Rich, and P. L. Sagalyn (Army Materials Technology Lab., Watertown, MA.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1189-1199 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N92-24208 Materials Research Labs., Ascot Vale (Australia).
COOKOFF BEHAVIOUR OF PYROTECHNICS
Leo V. deYong and Lance D. Redman Feb. 1992 38 p
(MRL-TR-91-44) Copyright Avail: Issuing Activity

The U.S. Navy has officially adopted a policy of Insensitive Munitions (IM) and the Australian Defense Forces are currently considering adopting a similar IM policy. One major area of uncertainty is whether pyrotechnic stores respond in an unacceptably violent manner to IM threat scenarios, and whether they should be subjected to rigorous IM testing. At present there is only a limited amount of information available on the response of pyrotechnics to the IM threat scenarios. The study reported in this paper generates some much needed data on the cookoff behavior of pyrotechnics. The results of the response of several pyrotechnic compositions to both fast and slow cookoff using the Super Small Scale Cookoff Bomb (SSCB) and the Small Scale Booster Cookoff Test (SSBCT), supported by differential scanning calorimetry and differential thermal analysis (DSC/DTA) data, are presented. The results suggest that most pyrotechnic compositions do not present a serious threat in terms of response to these test stimuli. Author

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology.*

N92-24612# European Space Agency, Paris (France).
THE IMPORTANCE OF SHORT DURATION (E.G. SOUNDING ROCKET) EXPERIMENTS WITHIN THE CONTEXT OF THE ESA MICROGRAVITY RESEARCH PROGRAMME
Paul Clancy *In its* 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 139-142 (For primary document see N92-24589 15-12)
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N92-24613# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (Germany, F.R.).
A NOVEL TV TRANSMISSION SYSTEM FOR LONG RANGE MICRO GRAVITY PAYLOADS
P. Turner *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 143-145 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24617# OHB-System G.m.b.H., Bremen (Germany, F.R.).
BALLOON-BORNE DROP CAPSULE MIKROBA
K. Kretzschmar, A. Kellig, and W. R. Kuebler (Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn, Germany, F.R.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 161-167 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24618# Italian Space Agency, Rome.
GIZERO: A SYSTEM TO PERFORM SCIENTIFIC EXPERIMENTATION UNDER MICROGRAVITY CONDITIONS USING STRATOSPHERIC BALLOONS
G. Rum, F. Fuligni, and V. Iafolla (Consiglio Nazionale delle Ricerche, Frascati, Italy) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 169-171 (For primary document see N92-24589 15-12)
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31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N92-25064# Oak Ridge Y-12 Plant, TN.
DEVELOPMENT OF BERYLLIUM MIRROR TURNING TECHNOLOGY
J. B. Arnold 1 Apr. 1991 12 p Presented at the SPIE International Symposium on Optical Engineering and Photonics in Aerospace Sensing, Orlando, FL, 1-5 Apr. 1991
(Contract DE-AC05-84OS-21400)
(DE92-008028; Y/DX-1186; CONF-910450-16) Avail: NTIS HC/MF A03

Because of the unique properties of beryllium (Be) and the advantages of single point turning, a development program has been instituted to single point turn beryllium as a means to produce optics. Initial effort to diamond turn beryllium resulted in less than desirable results and development efforts were directed at finding a more suitable tool material. Both single and polycrystalline tool materials were evaluated and cubic boron nitride (CBN) was found to produce the better results. Tool wear has been the primary limitation in precision machining beryllium and advances have allowed a two order-of-magnitude reduction in this problem. After considerable efforts, results with CBN appear to be approaching a limit, and diamond, as tool material, was re-evaluated with promising results. A development program is now under way to determine if diamond may be used to machine larger and more complex beryllium parts. DOE

N92-24385# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Leichtbau.
LARGE TRUSS STRUCTURES IN SPACE [GROSSE FACHWERKSTRUKTUREN IM WELTRAUM]
A. Rittweger *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 89-90 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24992*# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.
ARMY (MANTECH) THRUST AREA CONCEPT: OPTICS THRUST AREA
Stanley P. Kopacz *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 63-67 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

N92-24993*# National Inst. of Standards and Technology, Gaithersburg, MD.
INTELLIGENT PROCESSING EQUIPMENT DEVELOPMENTS WITHIN THE NAVY'S MANUFACTURING TECHNOLOGY CENTERS OF EXCELLENCE
Philip Nanzetta *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 68-73 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

N92-24994*# Defense Logistics Agency, Alexandria, VA. Manufacturing Engineering Branch.
INTELLIGENT PROCESSING EQUIPMENT PROJECTS AT DLA
Donald F. OBrien *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 74-77 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

N92-24995*# Strategic Defense Initiative Organization, Washington, DC. Producibility and Manufacturing Div.
SDIO PRODUCIBILITY AND MANUFACTURING INTELLIGENT PROCESSING PROGRAMS
Greg Stottlemyer *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 78-89 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

N92-24996*# IIT Research Inst., Chicago, IL. Manufacturing Technology Information Analysis Center.
MANUFACTURING TECHNOLOGY INFORMATION ANALYSIS CENTER: KNOWLEDGE IS STRENGTH
Michal Safar *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 90-94 Sponsored by DOD (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

N92-24998*# South Carolina Research Authority. Charleston.
RAMP TECHNOLOGY AND INTELLIGENT PROCESSING IN SMALL MANUFACTURING
Richard E. Rentz *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 102-124 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

N92-24999*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ASSESSMENT OF INTELLIGENT PROCESSING EQUIPMENT IN THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, 1991
C. S. Jones *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 125-164 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

N92-25001*# National Science Foundation, Washington, DC. Div. of Design and Manufacturing Systems.
INTELLIGENT PROCESSING EQUIPMENT RESEARCH SUPPORTED BY THE NATIONAL SCIENCE FOUNDATION
Suren B. Rao *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 176-187 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N92-24071*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCEEDINGS OF THE SECOND INTERNATIONAL MOBILE SATELLITE CONFERENCE (IMSC 1990)
R. W. Huck, comp., William Rafferty, comp., and D. Hugh M. Reekie, ed. 1990 772 p Conference held in Ottawa, Ontario, 17-20 Jun. 1990 Prepared in cooperation with Dept. of Communications, Ottawa, Ontario Original contains color illustrations
(NASA-CR-186321; JPL-Publ-90-7; NAS 1.26:186321; ISBN-0-9694639-0-1) Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Presented here are the proceedings of the Second International Mobile Satellite Conference (IMSC), held June 17-20, 1990 in Ottawa, Canada. Topics covered include future mobile satellite communications concepts, aeronautical applications, modulation and coding, propagation and experimental systems, mobile terminal equipment, network architecture and control, regulatory and policy considerations, vehicle antennas, and speech compression. For individual titles, see N92-24072 through N92-24197.

N92-24072*# Aussat Proprietary Ltd., Sydney (Australia).
MOBILESAT: AUSTRALIA'S OWN
Michael Wagg *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 3-7 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Australia will be introducing a dedicated Mobile Satellite Communications System following the launch of the AUSSAT-B satellites late in 1991. The Mobile Satellite System, MOBILESAT, will provide circuit switched voice/data services and packet-switched data services for land, aeronautical and maritime users. Here, an overview is given of the development program being undertaken within Australia to enable a fully commercial service to be introduced in 1992. Author

N92-24073*# International Maritime Satellite Organization, London (England).
IMPLEMENTATION OF INMARSAT MOBILE SATCOM SYSTEMS
Hans-Chr. Haugli *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 8-12 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Described here is the new mobile satcom systems being implemented by Inmarsat. Inmarsat has traditionally provided professional communication to ships and is now actively implementing new systems for use on land, in the air, and at sea. These new systems can provide near global communication for anyone on the move. By 1993, four new systems will provide telephony, telex, data, group call and facsimile at affordable cost to a very wide range of users. A table giving the main technical parameters for Inmarsat Aeronautical, Inmarsat-B, C, and M systems is provided. Author

N92-24074*# Qualcomm, Inc., San Diego, CA.
A SECOND ANNIVERSARY OPERATIONAL REVIEW OF THE OMNITRACS(R): THE FIRST TWO-WAY MOBILE KU-BAND SATELLITE COMMUNICATIONS SYSTEM
Irwin M. Jacobs, Allen Salmasi, Klein S. Gilhousen, Lindsay A. Weaver, Jr., and Thomas J. Bernard *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 13-18 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A novel two-way mobile satellite communications and vehicle position reporting system that is currently operational in the United States and Europe is described. The system characteristics and service operations are described in detail. Technical descriptions of the equipment and signal processing techniques are provided. Author

N92-24075*# Telesat Mobile, Inc., Ottawa (Ontario).
DOMESTIC MOBILE SATELLITE SYSTEMS IN NORTH AMERICA
Muya Wachira *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 19-27 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Telest Mobile Inc. (TMI) and the American Mobile Satellite Corporation (AMSC) are authorized to provide mobile satellite services (MSS) in Canada and the United States respectively. They are developing compatible systems and are undertaking joint specification and procurement of spacecraft and ground segment with the aim of operational systems by late 1993. Early entry (phase 1) mobile data services are offered in 1990 using space segment capacity leased from Inmarsat. Here, an overview is given of these domestic MSS with an emphasis on the TMI component of the MSAT systen. Author

N92-24076*# American Mobile Satellite Corp., Washington, DC.
THE AMERICAN MOBILE SATELLITE SYSTEM
William B. Garner *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 28-31 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

During 1989, the American Mobile Satellite Corporation (AMSC) was authorized to construct, launch, and operate satellites to provide mobile satellite services (MSS) to the U.S. and Puerto Rico. The AMSC has undertaken three major development programs to bring a full range of MSS services to the U.S. The first program is the space segment program that will result in the construction and launch of the satellites as well as the construction and installation of the supporting ground telemetry and command system. The second segment will result in the specification, design, development, construction, and installation of the Network Control System necessary for managing communications access to the satellites, and the specification and development of ground equipment for standard circuit switched and packet switched communications services. The third program is the Phase 1 program to provide low speed data services within the U.S. prior to availability of the AMSC satellites and ground segment. Described here are the present status and plans for these three programs as well as an update on related business arrangements and regulatory matters. Author

N92-24077*# Geostar Messaging Corp., Washington, DC.
IMPLEMENTATION OF GEOSTAR'S RDSS SYSTEM
Ronald J. Lepkowski *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 33-36 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The Geostar (Trademark) system began its initial operations in 1988 and was the first domestic satellite system to provide regular service to mobile users within the United States. Here, an overview is given of Geostar's radiodetermination satellite system (RDSS) concept and its development by Geostar, with a focus on the current operational status of Geostar's interim RDSS system and services. Author

N92-24078*# European Space Agency, Paris (France). Telecommunications Directorate.
INTEGRATION BETWEEN TERRESTRIAL-BASED AND SATELLITE-BASED LAND MOBILE COMMUNICATIONS SYSTEMS
Antonio Arcidiancono *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 39-45 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A survey is given of several approaches to improving the performance and marketability of mobile satellite systems (MSS). The provision of voice/data services in the future regional European Land Mobile Satellite System (LMSS), network integration between the Digital Cellular Mobile System (GSM) and LMSS, the identification of critical areas for the implementation of integrated GSM/LMSS areas, space segment scenarios, LMSS for digital trunked private mobile radio (PMR) services, and code division multiple access (CDMA) techniques for a terrestrial/satellite system are covered. Author

N92-24079*# Department of Communications, Ottawa (Ontario).
SPECTRUM AND ORBIT CONSERVATION AS A FACTOR IN FUTURE MOBILE SATELLITE SYSTEM DESIGN
Robert R. Bowen *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 46-50 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Access to the radio spectrum and geostationary orbit is essential to current and future mobile satellite systems. This access is difficult to obtain for current systems, and may be even more so for larger future systems. In this environment, satellite systems that minimize the amount of spectrum orbit resource required to meet a specific traffic requirement are essential. Several spectrum conservation techniques are discussed, some of which are complementary to designing the system at minimum cost. All may need to be implemented to the limits of technological feasibility if network growth is not to be constrained because of the lack of available spectrum-orbit resource. Author

N92-24080*# Scotgroup Enterprises, Inc., Montreal (Quebec).
PERSONAL COMMUNICATIONS: AN EXTENSION TO THE MOBILE SATELLITE
Murray Epstein and Francois Draper *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 51-55 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

As time progresses, customer demands become far more universal, involving integrated, simple to operate, cost effective services, with technology virtually transparent to the operator. Industry will be in a position of providing the necessary services to meet the subscribers' needs. Our resource based industries, transportation services, and utilities in the more rural and unserviced areas will require quality and affordable services that can only be supplied via satellite. One answer to these needs will be one- and two-way interoperable data messaging. Author

N92-24081*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
A SATELLITE-BASED PERSONAL COMMUNICATION SYSTEM FOR THE 21ST CENTURY
Miles K. Sue, Khaled Dessouky, Barry Levitt, and William Rafferty *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 56-63 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Interest in personal communications (PCOMM) has been stimulated by recent developments in satellite and terrestrial mobile communications. A personal access satellite system (PASS) concept was developed at the Jet Propulsion Laboratory (JPL) which has many attractive user features, including service diversity and a handheld terminal. Significant technical challenges addressed in formulating the PASS space and ground segments are discussed. PASS system concept and basic design features, high risk enabling technologies, an optimized multiple access scheme, alternative antenna coverage concepts, the use of non-geostationary orbits, user terminal radiation constraints, and user terminal frequency reference are covered. Author

N92-24082*# Bradford Univ. (England).
FUTURE MOBILE SATELLITE COMMUNICATION CONCEPTS AT 20/30 GHz
S. K. Barton and J. R. Norbury (Rutherford Appleton Lab., Chilton, England) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 64-69 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The outline of a design of a system using ultra small earth stations (picoterminals) for data traffic at 20/30 GHz is discussed. The picoterminals would be battery powered, have an RF transmitter power of 0.5 W, use a 10 cm square patch antenna, and have a receiver G/T of about -8 dB/K. Spread spectrum modulation would be required (due to interference consideration) to allow a telex type data link (less than 200 bit/s data rate) from the picoterminal to the hub station of the network and about 40 kbit/s on the outbound patch. An Olympus type transponder at 20/30 GHz could maintain several thousand simultaneous picoterminal circuits. The possibility of demonstrating a picoterminal network with voice traffic using Olympus is discussed together with fully mobile systems based on this concept. Author

N92-24083*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). RF System Div.

A SATELLITE MOBILE COMMUNICATION SYSTEM BASED ON BAND-LIMITED QUASI-SYNCHRONOUS CODE DIVISION MULTIPLE ACCESS (BLQS-CDMA)

R. DeGaudenzi, C. Elia, and R. Viola *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 70-77 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Discussed here is a new approach to code division multiple access applied to a mobile system for voice (and data) services based on Band Limited Quasi Synchronous Code Division Multiple Access (BLQS-CDMA). The system requires users to be chip synchronized to reduce the contribution of self-interference and to make use of voice activation in order to increase the satellite power efficiency. In order to achieve spectral efficiency, Nyquist chip pulse shaping is used with no detection performance impairment. The synchronization problems are solved in the forward link by distributing a master code, whereas carrier forced activation and closed loop control techniques have been adopted in the return link. System performance sensitivity to nonlinear amplification and timing/frequency synchronization errors are analyzed. Author

N92-24084*# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).

LOOPUS MOB-D: SYSTEM CONCEPT FOR A PUBLIC MOBILE SATELLITE SYSTEM PROVIDING INTEGRATED DIGITAL SERVICES FOR THE NORTHERN HEMISPHERE FROM AN ELLIPTICAL ORBIT

H. Kuhlen and P. Horn *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 78-82 Previously announced as N91-15467 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A new concept for a satellite based public mobile communications system, LOOPUS Mob-D, is introduced, whereby most of the classical problems in mobile satellite systems are approached in a different way. The LOOPUS system will offer a total capacity of 6000 high rate channels in three service areas (Europe, Asia, and North America), covering the entire Northern Hemisphere with a set of group special mobile (GSM) compatible mobile services, eventually providing the 'office in the car'. Special characteristics of the LOOPUS orbit and the communications network architecture are highlighted. Author

N92-24085*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

USE OF ELLIPTICAL ORBITS FOR A KA-BAND PERSONAL ACCESS SATELLITE SYSTEM **c13**

Masoud Motamedi and Polly Estabrook *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 83-89 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The use of satellites in elliptical orbits for a Ka-band personal communications system application designed to provide voice and data service within the continental U.S. is examined. The impact of these orbits on system parameters such as signal carrier-to-noise ratio, roundtrip delay, Doppler shift, and satellite antenna size is quantized for satellites in two elliptical orbits, the Molniya and the ACE orbits. The number of satellites necessary for continuous CONUS coverage has been determined for the satellites in these orbits. The increased system complexity brought about by the use of satellites at such altitudes is discussed. Author

N92-24086*# Ministry of Posts and Telecommunications, Tokyo (Japan). Communications Research Lab.

MULTI-CARRIER MOBILE TDMA SYSTEM WITH ACTIVE ARRAY ANTENNA

Ryutaro Suzuki, Yasushi Matsumoto, and Naokazu Hamamoto *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 90-94 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A multi-carrier time division multiple access (TDMA) is proposed for the future mobile satellite communications systems that include a multi-satellite system. This TDMA system employs the active array antenna in which the digital beam forming technique is adopted to control the antenna beam direction. The antenna beam forming is carried out at the base band frequency by using the digital signal processing technique. The time division duplex technique is applied for the TDM/TDMA burst format, in order not to overlap transmit and receive timing. Author

N92-24087*# Canadian Astronautics Ltd., Ottawa (Ontario).

A LAND MOBILE SATELLITE DATA SYSTEM

John D. B. Kent *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 97-102 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The Telesat Mobile Incorporated (TMI) Mobile Data System (MDS) was developed to apply satellite technology to the transportation industry's requirement for a fleet management system. It will provide two-way messaging and automatic position reporting capabilities between dispatch centers and customers' fleets of trucks. The design was based on the Inmarsat L-Band space segment with system link parameters and margins adjusted to meet the land mobile satellite channel characteristics. The system interfaces with the Teleglobe Des Laurentides earth station at Weir, Quebec. The signaling protocols were derived from the Inmarsat Standard C packet signalling system with unique trucking requirements incorporated where necessary. Author

N92-24088*# Ministry of Posts and Telecommunications, Kashima (Japan). Communications Research Lab.

HYBRID SYSTEM OF COMMUNICATION AND RADIO DETERMINATION USING TWO GEOSTATIONARY SATELLITES

Shingo Ohmori, Yasushi Matsumoto, Eihisa Morikawa, and Masayoshi Wakao (Research and Development Center for Radio Systems, Tokyo, Japan) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 103-108 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A new hybrid satellite system which can provide both communications and positioning services in one system using two geostationary satellites is discussed. The distinctive feature is that location information can be provided by transmitting and receiving ranging signals over the same channel as communications through two geostationary satellites. Author

N92-24089*# Italspazio, Rome (Italy).

POSITION REPORTING SYSTEM USING SMALL SATELLITES

B. Pavesi, G. Rondinelli, and F. Graziani (La Sapienza Univ., Rome, Italy) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 109-116 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A system able to provide position reporting and monitoring services for mobile applications represents a natural complement to the Global Positioning System (GPS) navigation system. The system architecture is defined on the basis of the communications requirements derived by user needs, allowing maximum flexibility in the use of channel capacity, and a very simple and low cost terminal. The payload is sketched, outlining the block modularity and the use of qualified hardware. The global system capacity is also derived. The spacecraft characteristics are defined on the basis of the payload requirements. A small bus optimized for Ariane IV, Delta II vehicles and based on the modularity concept is presented. The design takes full advantage of each launcher with a common basic bus or bus elements for a mass production. Author

N92-24090*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SATELLITE SOUND BROADCASTING SYSTEM STUDY: MOBILE CONSIDERATIONS
Nasser Golshan *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 117-123 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Discussed here is the mobile reception part of a study to investigate a satellite sound broadcast system in the UHF or L bands. Existing propagation and reception measurements are used with proper interpretation to evaluate the signaling, coding, and diversity alternatives suitable for the system. Signal attenuation in streets shadowed by buildings appear to be around 29 db, considerably higher than the 10 db adopted by CCIR. With the marriage of proper technologies, an LMSS class satellite can provide substantial direct satellite audio broadcast capability in UHF or L bands for high quality mobile and portable indoor reception by low cost radio receivers. This scheme requires terrestrial repeaters for satisfactory mobile reception in urban areas. A specialized bandwidth efficient spread spectrum signalling technique is particularly suitable for the terrestrial repeaters. Author

N92-24091*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MULTIPLE ACCESS CAPACITY TRADE-OFFS FOR A KA-BAND PERSONAL ACCESS SATELLITE SYSTEM
Khaled Dessouky and Masoud Motamedi *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 124-130 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

System capability is critical to the economic viability of a personal satellite communication system. Ka band has significant potential to support a high capacity multiple access system because of the availability of bandwidth. System design tradeoffs are performed and multiple access schemes are compared with the design goal of achieving the highest capacity and efficiency. Conclusions regarding the efficiency of the different schemes and the achievable capacities are given. Author

N92-24092*# Bologna Univ. (Italy). Dipt. di Elettronica, Informatica e Sistemistica.
FEASIBILITY OF AN EHF (40/50 GHz) MOBILE SATELLITE SYSTEM USING HIGHLY INCLINED ORBITS
G. Falciasecca, A. Paraboni, M. Ruggieri, F. Valdoni, and F. Vatalaro (Rome Univ., Italy) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 131-135 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The pan-European L-band terrestrial cellular system (GSM) is expected to provide service to more than 10 million users by the year 2000. Discussed here is the feasibility of a new satellite system at EHF (40/50 GHz) to complement, at the end of the decade, the GSM system or its decendants in order to provide additional services at 64 kbits/s, or so. The main system aspects, channel characteristics, technology issues, and both on-board and earth terminal architectures are highlighted. Based on the performed analyses, a proposal was addressed to the Italian Space Agency (ASI), aimed at the implementation of a national plan. Author

N92-24093*# Geostar Messaging Corp., Washington, DC.
A NEW DIGITAL LAND MOBILE SATELLITE SYSTEM
Philip Schneider *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 136-141 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A description is given of the different digital services planned to be carried over existing and planned mobile satellite systems. These systems are then compared with analog services in terms of bandwidth and power efficiency. This comparison provides the rationale for the establishment of a digital land mobile satellite service (DLMSS) to use frequencies that are currently available but not yet assigned to a domestic mobile satellite system in the United States. The focus here is on the expected advantages of digital transmission techniques in accommodating additional mobile satellite systems in this portion of the spectrum, and how such techniques can fully satisfy voice, data and facsimile mobile communications requirements in a cost effective manner. A description is given of the system architecture of the DMLSS service proposed by the Geostar Messaging Corporation (GMC) and the market potential of DLMSS. Author

N92-24094*# Department of Defense, Fort Meade, MD.
TRANSITIONING FROM ANALOG TO DIGITAL COMMUNICATIONS: AN INFORMATION SECURITY PERSPECTIVE
Richard A. Dean *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 142-146 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A summary is given of the government's perspective on evolving digital communications as they affect secure voice users and approaches for operating during a transition period to an all digital world. An integrated architecture and a mobile satellite interface are discussed. Author

N92-24095*# International Maritime Satellite Organization, London (England). Aeronautical Services Div.
AERONAUTICAL SATELLITE SYSTEM TEST AND IMPLEMENTATION Abstract Only
Keith Smith *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 149 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

This contribution reports on various aspects of the test and implementation of the new worldwide aeronautical satellite system. The system will be implemented in 1990 following several years of system design and equipment development. The full range of services and equipment will not be available immediately, but rather there will be a progressive phase-in over the first two years of service. Data services using low gain aircraft antennas are planned to be introduced first. Voice service, requiring high gain antennas is expected to begin on a full scale basis about May/June 1990. This contribution explains Inmarsat's approach to testing and authorization of equipment intended to make use of its satellites in this evolving situation. The approach is designed to permit progressive implementation of services while avoiding the need for large scale retrofitting of equipment which has already been introduced into service. Author

N92-24096*# Canadian Marconi Co. Ltd., Kanata (Ontario).
A HIGH GAIN ANTENNA SYSTEM FOR AIRBORNE SATELLITE COMMUNICATION APPLICATIONS
M. Maritan and M. Borgford *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 150-155 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A high gain antenna for commercial aviation satellites communication is discussed. Electromagnetic and practical design considerations as well as candidate systems implementation are presented. An evaluation of these implementation schemes is given, resulting in the selection of a simple top mounted aerodynamic phased array antenna with a remotely located beam steering unit. This concept has been developed into a popular product known as the Canadian Marconi Company CMA-2100. A description of the technical details is followed by a summary of results from the first production antennas. Author

N92-24097*# Boeing Commercial Airplane Co., Seattle, WA.
FLIGHT TEST OF ARINC 741 CONFIGURATION LOW GAIN SATCOM SYSTEM ON BOEING 747-400 AIRCRAFT
Timothy A. Murphy and Brian P. Stapleton *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 157-162 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The Boeing company conducted a flight test of a SATCOM system similar to the ARINC 741 configuration on a production model 747-400. A flight plan was specifically designed to test the system over a wide variety of satellite elevations and aircraft attitudes as well as over land and sea. Interface bit errors, signal quality and aircraft position and navigational inputs were all recorded as a function of time. Special aircraft maneuvers were performed to demonstrate the potential for shadowing by aircraft structures. Both a compass rose test and the flight test indicated that shadowing from the tail is insignificant for the 747-400. However, satellite elevation angles below the aircraft horizon during banking maneuvers were shown to have a significant deleterious effect on SATCOM communications. Author

N92-24098*# International Maritime Satellite Organization, London (England).
INMARSAT AERONAUTICAL MOBILE SATELLITE SYSTEM: INTERNETWORKING ISSUES
Jay R. Sengupta *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 163-168 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The Inmarsat Aeronautical Mobile Satellite System (AMSS) provides air-ground and air-air communications services to aero-mobile users on a global basis. Communicating parties may be connected either directly, or more commonly, via interconnecting networks to the Inmarsat AMSS, in order to construct end-to-end communications circuits. The aircraft earth station (AES) and the aeronautical ground earth station (GES) are the points of interconnection of the Inmarsat AMSS to users, as well as to interconnecting networks. This paper reviews the internetworking aspects of the Inmarsat AMSS, by introducing the Inmarsat AMSS network architecture and services concepts and then discussing the internetwork address/numbering and routing techniques. Author

N92-24099*# Canadian Astronautics Ltd., Ottawa (Ontario).
LOW COST, ELECTRONICALLY STEERED PHASED ARRAY FOR GENERAL AVIATION
Peter C. Strickland *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 169-171 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

This paper describes a multifaced, phased array antenna developed for general aviation satellite communications applications. The antenna design satisfies all INMARSAT Aeronautical SDM requirements. Unique features of this antenna include an integral LNA and diplexer, integral phase shifters which are shared among the array faces, a serial beam steering interface and low manufacturing cost. Author

N92-24100*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
COMBINED TRELLIS CODING AND FEEDFORWARD PROCESSING FOR MSS APPLICATIONS
D. Divsalar, M. K. Simon, T. Jedrey, N. Lay, and W. Rafferty *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 175-181 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The idea of using a multiple (more than two) symbol observation interval to improve error probability performance is applied to differential detection of trellis coded MPSK over a mobile satellite (fading) channel. Results are obtained via computer simulation. It is shown that only a slight increase (e.g., one symbol) in the length of the observation interval will provide a significant improvement in bit error probability performance both in AWGN and fading environments. Author

N92-24101*# Communications Research Centre, Ottawa (Ontario).
AN IMPLEMENTATION OF A REFERENCE SYMBOL APPROACH TO GENERIC MODULATION IN FADING CHANNELS
R. J. Young, J. H. Lodge, and L. C. Pacola *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 182-187 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

As mobile satellite communications systems evolve over the next decade, they will have to adapt to a changing tradeoff between bandwidth and power. This paper presents a flexible approach to digital modulation and coding that will accommodate both wideband and narrowband schemes. This architecture could be the basis for a family of modems, each satisfying a specific power and bandwidth constraint, yet all having a large number of common signal processing blocks. The implementation of this generic approach, with general purpose digital processors for transmission of 4.8 kilobits per sec. digitally encoded speech, is described. Author

N92-24102*# Motorola, Inc., Austin, TX. Digital Signal Processing Operations.
ACOUSTIC ECHO CANCELLATION FOR FULL-DUPLEX VOICE TRANSMISSION ON FADING CHANNELS
Sangil Park and Dion D. Messer *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 188-193 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

This paper discusses the implementation of an adaptive acoustic echo canceler for a hands-free cellular phone operating on a fading channel. The adaptive lattice structure, which is particularly known for faster convergence relative to the conventional tapped-delay-line (TDL) structure, is used in the initialization stage. After convergence, the lattice coefficients are converted into the coefficients for the TDL structure which can accommodate a larger number of taps in real-time operation due to its computational simplicity. The conversion method of the TDL coefficients from the lattice coefficients is derived and the DSP56001 assembly code for the lattice and TDL structure is included, as well as simulation results and the schematic diagram for the hardware implementation. Author

N92-24103*# Hughes Network Systems, Inc., Germantown, MD.
FEC DECODER DESIGN OPTIMIZATION FOR MOBILE SATELLITE COMMUNICATIONS
Ashim Roy and Leng Lewi *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 194-199 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A new telecommunications service for location determination via satellite is being proposed for the continental USA and Europe, which provides users with the capability to find the location of, and communicate from, a moving vehicle to a central hub and vice versa. This communications system is expected to operate in an extremely noisy channel in the presence of fading. In order to achieve high levels of data integrity, it is essential to employ forward error correcting (FEC) encoding and decoding techniques in such mobile satellite systems. A constraint length $k = 7$ FEC decoder has been implemented in a single chip for such systems. The single chip implementation of the maximum likelihood decoder helps to minimize the cost, size, and power consumption, and

improves the bit error rate (BER) performance of the mobile earth terminal (MET). Author

N92-24104*# Nippon Telegraph and Telephone Public Corp., Yokosuka (Japan). Communication Systems Lab.

SOFT-DECISION VITERBI DECODING WITH DIVERSITY COMBINING

T. Sakai, K. Kobayashi, and S. Kato *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 200-204 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Diversity combining methods for convolutional coded and soft-decision Viterbi decoded channels in mobile satellite communications systems are evaluated and it is clarified that the pre-Viterbi-decoding maximal ratio combining shows better performance than other methods in Rician fading channels by computer simulation. A novel practical technique for maximal ratio combining is proposed, in which the coefficients for weighting are derived from soft-decision demodulated signals only. The proposed diversity combining method with soft-decision Viterbi decoding requires simple hardware and shows satisfactory performance with slight degradation of 0.3 dB in Rician fading channels compared with an ideal weighting scheme. Furthermore, this diversity method is applied to trellis coded modulation and significant Pe performance improvement is achieved. Author

N92-24105*# Motorola, Inc., Austin, TX. Digital Signal Processing Operations.

A SIMPLE IMPLEMENTATION OF THE VITERBI ALGORITHM ON THE MOTOROLA DSP56001

Dion D. Messer and Sangil Park *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 205-209 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

As systems designers design communication systems with digital rather than analog components to reduce noise and increase channel capacity, they must have the ability to perform traditional communication algorithms digitally. The use of trellis coded modulation as well as the extensive use of convolutional encoding for error detection and correction requires an efficient digital implementation of the Viterbi Algorithm for real time demodulation and decoding. Digital signal processors are now fast enough to implement Viterbi decoding in conjunction with the normal receiver/transmitter functions for lower speed channels on a single chip as well as performing fast decoding for higher speed channels, if the algorithm is implemented efficiently. The purpose of this paper is to identify a good way to implement the Viterbi Algorithm (VA) on the Motorola DSP56001, balancing performance considerations with speed and memory efficiency. Author

N92-24106*# Aussat Proprietary Ltd., Sydney (Australia).

TECHNICAL DEVELOPMENT FOR AUSTRALIA'S MOBILESAT SYSTEM

Kim Dinh, Nick Hart, and Steve Harrison *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 213-218 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

With the planned introduction in Australia of the mobile satellite service in mid-1992, MOBILESAT will be the first domestic mobile satellite system with full voice and data capability to be in operation worldwide. This paper describes the technical features which have been adopted by MOBILESAT in providing a unique system optimized for land mobile operation and the technical activities which have been carried out by AUSSAT in the past three years in supporting the development of the system. Author

N92-24107*# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.

AN OVERVIEW OF RESULTS DERIVED FROM MOBILE-SATELLITE PROPAGATION EXPERIMENTS

Julius Goldhirsh and Wolfhard J. Vogel (Texas Univ., Austin.) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 219-224 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

During the period 1983-1988, a series of Land Mobile Satellite Service (LMSS) propagation experiments were performed. These experiments were implemented with transmitters on stratospheric balloons, remotely piloted aircraft, helicopters, and geostationary satellites. The earlier experiments were performed at UHF (870 mega-Hz) and the latter at both L band (1.5 giga-Hz) and UHF. The general objective of the above tests was to assess the impairment to propagation caused by trees and terrain for predominantly suburban and rural regions where cellular communication services are impractical. This paper presents an overview of the results derived from the above experiments. Author

N92-24108*# Laval Univ. (Quebec). Dept. of Electrical Engineering.

EFFECTS OF FADE DISTRIBUTION ON A MOBILE SATELLITE DOWNLINK AND UPLINK PERFORMANCE IN A FREQUENCY REUSE CELLULAR CONFIGURATION

Karl Boutin, Michel Lecours, Marcel Pelletier, and Gilles Y. Delisle *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 225-230 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

In a mobile satellite system with a frequency reuse cellular configuration, significant co-channel interference can be experienced due to the antenna sidelobe level. The signal will be subjected not only to its own fading, but also to the effect of the varying degree of fading on co-channel interferer, and this interference will behave differently in the up and in the down link. This paper presents a quantitative evaluation of the combined effects of fades and co-channel interference on a mobile satellite link. Author

N92-24109*# Surrey Univ., Guildford (England).

A PROPAGATION EXPERIMENT FOR MODELLING HIGH ELEVATION ANGLE LAND MOBILE SATELLITE CHANNELS

M. Richharia, B. G. Evans, and G. Butt *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 231-238 (For primary document see N92-24071 15-32)

(Contract ESA-8084/88/NL/PB)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

This paper summarizes the results of a feasibility study for conducting high elevation angle propagation experiments in the European region for land mobile satellite communication. The study addresses various aspects of a proposed experiment. These include the selection of a suitable source for transmission, possibility of gathering narrow and wide band propagation data in various frequency bands, types of useful data, data acquisition technique, possible experimental configuration, and other experimental details. Author

N92-24110*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

FIELD TRIALS OF A NASA-DEVELOPED MOBILE SATELLITE TERMINAL

Khaled Dessouky, Richard F. Emerson, Loretta Ho, and Thomas C. Jedrey *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 239-245 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Various field trials have been performed to validate and optimize the technologies developed by the Mobile Satellite Experiment (MSAT-X). For each of the field experiments performed, a brief description of the experiment is provided, followed by a summary of the experimental results. Emphasis is placed on the two full scale land mobile and aeronautical mobile experiments.

Experiments planned for the near future are also presented.
Author

N92-24111*# Ministry of Posts and Telecommunications, Kashima (Japan). Communications Research Lab.
SPREAD SPECTRUM MOBILE COMMUNICATION EXPERIMENT USING ETS-V SATELLITE
Tetsushi Ikegami, Ryutaro Suzuki, Naoto Kadowaki, Shinichi Taira, and Nobuyasu Sato (Toshiba Corp., Kawasaki, Japan) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 246-252 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The spread spectrum technique is attractive for application to mobile satellite communications, because of its random access capability, immunity to inter-system interference, and robustness to overloading. A novel direct sequence spread spectrum communication equipment is developed for land mobile satellite applications. The equipment is developed based on a matched filter technique to improve the initial acquisition performance. The data rate is 2.4 kilobits per sec. and the PN clock rate is 2.4552 mega-Hz. This equipment also has a function of measuring the multipath delay profile of land mobile satellite channel, making use of a correlation property of a PN code. This paper gives an outline of the equipment and the field test results with ETS-V satellite.
Author

N92-24112*# Communications Research Centre, Ottawa (Ontario).
AN OCEAN SCATTER PROPAGATION MODEL FOR AERONAUTICAL SATELLITE COMMUNICATION APPLICATIONS
K. W. Moreland *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 253-258 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

In this paper an ocean scattering propagation model, developed for aircraft-to-satellite (aeronautical) applications, is described. The purpose of the propagation model is to characterize the behavior of sea reflected multipath as a function of physical propagation path parameters. An accurate validation against the theoretical far field solution for a perfectly conducting sinusoidal surface is provided. Simulation results for typical L band aeronautical applications with low complexity antennas are presented. Author

N92-24113*# Canadian Astronautics Ltd., Ottawa (Ontario).
A SATELLITE DATA TERMINAL FOR LAND MOBILE USE
Colin A. Sutherland *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 261-266 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Telesat Mobile Incorporated (TMI) has recently introduced the Mobile Data Service (MDS) into Canada. This paper outlines the system design and some key aspects of the detailed design of the Mobile Earth Terminal (MET) developed by Canadian Aeronautics Limited (CAL) for use with the MDS. The technical requirements for the MET are outlined and the equipment architecture is described. The major design considerations for each functional module are then addressed. Environmental conditions unique to the land mobile service are highlighted, along with the measures taken to ensure satisfactory operation and survival of the MET. Finally, the probable direction of future developments is indicated.
Author

N92-24114*# Fujitsu Ltd., Kawasaki (Japan). Radio and Satellite Communication Systems Lab.
A SPREAD-SPECTRUM MODEM USING CONSTANT ENVELOPE BPSK FOR A MOBILE SATELLITE COMMUNICATIONS TERMINAL
N. Iizuka, A. Yamashita, S. Takenaka, E. Morikawa, and T. Ikegami (Ministry of Posts and Telecommunications, Kashima, Japan) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 267-271 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

This paper describes a 5-kilobit/s spread spectrum modem with a 1.275 mega-Hz chip rate for mobile satellite communications. We used a Viterbi decoder with a coding gain of 7.8 dB at a BER of 10(exp -5) to decrease the required receiver power. This reduces the cost of communication services. The spread spectrum technique makes the modem immune to terrestrial radio signals and keeps it from causing interference in terrestrial radio systems. A class C power amplifier reduces the modem's power consumption. To avoid nonlinear distortion caused by the amplifier, the envelope of the input signal is kept constant by adding quadrature channel signal to the BPSK signal. To simulate the worst case, we measured the modem's output spectrum using a limiting amplifier instead of the class C amplifier, and found that 99 percent of the spectral power was confined to the specified 2.55 mega-Hz bandwidth.
Author

N92-24115*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DESCRIPTION AND PERFORMANCE OF A DIGITAL MOBILE SATELLITE TERMINAL
N. Lay, T. Jedrey, J. Parkyn, and D. Divsalar *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 272-278 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A major goal of the Mobile Satellite Experiment (MSAT-X) program at the Jet Propulsion Lab (JPL) is the development of an advanced digital terminal for use in land mobile satellite communication. The terminal has been developed to minimize the risk of applying advanced technologies to future commercial mobile satellite systems (MSS). Testing with existing L band satellites was performed in fixed, land mobile and aeronautical mobile environments. JPL's development and tests of its mobile terminal have demonstrated the viability of narrowband digital voice communications in a land mobile environment through geostationary satellites. This paper provides a consolidated description of the terminal architecture and the performance of its individual elements.
Author

N92-24116*# SkyWave Electronics Ltd., Kanata (Ontario).
L-BAND BRIEFCASE TERMINAL NETWORK OPERATION
P. Rossiter, D. Reveler, and L. Tibbo *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 279-284 (For primary document see N92-24071 15-32)
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During 1989, SkyWave Electronics Ltd. developed a lightweight battery powered, L Band Briefcase Satellite Terminal (LBT) which is capable of providing truly portable voice and data communications on a global scale. The LBT is designed to operate through Inmarsat's Atlantic Region Satellite MARECSB-2, and Teleglobe Canada's 18 meter Laurentides Earth Station. A small operating network, consisting of up to 20 mobile terminals and homing on the Laurentides Earth Station, was set up in the spring of 1990 to provide commercial service to LBT users, both domestic and international. This paper describes the LBT and the operation of the network.
Author

N92-24117*# Qualcomm, Inc., San Diego, CA.
A DESCRIPTION OF QUALCOMM AUTOMATIC SATELLITE POSITION REPORTING (QASPR(R)) FOR MOBILE COMMUNICATIONS
William G. Ames *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 285-290 (For primary document see N92-24071 15-32)
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Two satellite position reporting has been introduced into the OmniTRACS mobile satellite communication system. This system

significantly improves position reporting reliability and accuracy while simplifying the terminal's hardware. The positioning technique uses the original OmniTRACS TDMA timing signal formats in the forward and return link directions plus an auxiliary, low power forward link signal through a second satellite to derive distance values. The distances are then converted into the mobile terminal's latitude and longitude in real time. A minor augmentation of the spread spectrum profile of the return link allowed the resolution of periodic ambiguities. The system also locates the two satellites in real time with fixed platforms in known locations using identical mobile terminal hardware. Initial accuracies of 1/4 mile have been realized uniformly throughout the USA using a satellite separation of 22 degrees and there are no dead zones, skywaves, or cycle slips as found in terrestrial systems like LORAN-C. Author

N92-24118*# Bristol Univ. (England). Centre for Communications Research.

MOBILE TERMINAL EQUIPMENT DESIGN UTILISING SPLIT-LOOP PHASE-LOCK TECHNIQUES

P. B. Kenington, J. P. McGeehan, and D. J. Edwards (Oxford Univ., England) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 292-296 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The design and resultant performance of the terminal equipment in a mobile satellite system is vitally important in respect to the overall cost/performance compromise of the whole system. Improvements in system performance which also result in a reduction of the equipment cost are rare. However, this paper details a significant advance in terminal design, utilizing a novel form of 'split-loop' phase locked receiver/downconverter system to enable an accurate, stable and wide coverage terminal to be realized at a reduced cost. The system has the capability of automatically locking onto any carrier within a complete transponder, and can cope with severe amplitude modulation and fading effects. Author

N92-24119*# Bristol Univ. (England). Centre for Communications Research.

LINEAR TRANSMITTER DESIGN FOR MSAT TERMINALS

Ross Wilkinson, John MacLeod (Footscray Inst. of Tech., Australia), Mark Beach, and Andrew Bateman *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 297-301 (For primary document see N92-24071 15-32)

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One of the factors that will undoubtedly influence the choice of modulation format for mobile satellites, is the availability of cheap, power-efficient, linear amplifiers for mobile terminal equipment operating in the 1.5-1.7 GHz band. Transmitter linearity is not easily achieved at these frequencies, although high power (20W) class A/AB devices are becoming available. However, these components are expensive and require careful design to achieve a modest degree of linearity. In this paper an alternative approach to radio frequency (RF) power amplifier design for mobile satellite (MSAT) terminals using readily-available, power-efficient, and cheap class C devices in a feedback amplifier architecture is presented. Author

N92-24120*# Simon Fraser Univ., Burnaby (British Columbia). Communications Science Lab.

INTEGRATED DSP/RF DESIGN FOR AN MSAT TRANSMITTER

S. P. Stapleton and J. K. Cavers *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 302-307 Sponsored in part by the British Columbia Science and Technology Development Fund (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

In mobile radio systems, the relatively inefficient use of the spectrum by existing Frequency Modulation (FM) techniques is limiting the available channels. Linear modulation methods are thought to provide the necessary push into more efficient usage of the spectrum. The limitation, to date, of the linear modulation techniques is the fact that the nonlinear power amplifier tends to spread the spectrum and thus offset any spectrum efficiency advantage. Linearization techniques are presently being investigated, in the literature, in order to recover some of the lost spectrum, due to spreading. To this end, digital signal processing (DSP) techniques are thought to provide real time predistortion methods. Some of the complex modulation blocks, normally confined to analog circuitry, are being implemented using DSP circuitry. This paper will address the linearization techniques, for mobile satellite (MSAT) transceivers, that use an integrated DSP/radio frequency design. Author

N92-24121*# Telesat Mobile, Inc., Ottawa (Ontario).

MSAT NETWORK ARCHITECTURE

N. G. Davies and B. Skerry *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 311-316 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The Mobile Satellite (MSAT) communications system will support mobile voice and data services using circuit switched and packet switched facilities with interconnection to the public switched telephone network and private networks. Control of the satellite network will reside in a Network Control System (NCS) which is being designed to be extremely flexible to provide for the operation of the system initially with one multi-beam satellite, but with capability to add additional satellites which may have other beam configurations. The architecture of the NCS is described. The signalling system must be capable of supporting the protocols for the assignment of circuits for mobile public telephone and private network calls as well as identifying packet data networks. The structure of a straw-man signalling system is discussed. Author

N92-24122*# American Mobile Satellite Corp., Washington, DC.

THE AMSC NETWORK CONTROL SYSTEM

William B. Garner *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 317-322 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The American Mobile Satellite Corporation (AMSC) is going to construct, launch, and operate a satellite system in order to provide mobile satellite services to the United States. AMSC is going to build, own, and operate a Network Control System (NCS) for managing the communications usage of the satellites, and to control circuit switched access between mobile earth terminals and feeder-link earth stations. An overview of the major NCS functional and performance requirements, the control system physical architecture, and the logical architecture is provided. Author

N92-24123*# Telesat Mobile, Inc., Ottawa (Ontario).

AN ARCHITECTURE FOR THE MSAT MOBILE DATA SYSTEM

R. W. Kerr and B. Skerry *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 323-327 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The Mobile Satellite (MSAT) Mobile Data System (MDS) will offer a wide range of packet switched data services. The characteristics and requirements of the services are briefly examined. A proposed architecture to implement these services is presented along with its connectivity requirements. A description of the inbound and outbound channels is provided which are based upon the signalling for the circuit switched services. Additionally, the duties of the Network Management System are examined. Author

N92-24124*# Centro Studi e Laboratori Telecomunicazioni, Turin (Italy).

MESSAGE HANDLING SYSTEM CONCEPTS AND SERVICES IN A LAND MOBILE SATELLITE SYSTEM

S. Barberis, F. Settimo, A. Giralda, I. Mistretta, C. Loisy, and J. L.

Parmentier (SAIT, Italy) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 328-333 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A network architecture containing the capabilities offered by the Message Handling System (MHS) to the PRODAT Land Mobile Satellite System (LMSS) is described taking into account the constraints of a preexisting satellite system which is going to become operational. The mapping between MHS services and PRODAT requirements is also reported and shows that the supplied performance can be significantly enhanced to both fixed and mobile users. The impact of the insertion of additional features on the system structure, especially on the centralized control unit, are also addressed. Author

N92-24125*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN ALTERNATIVE RESOURCE SHARING SCHEME FOR LAND MOBILE SATELLITE SERVICES
Tsun-Yee Yan and Miles K. Sue *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 334-340 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A preliminary comparison between the two competing channelization concepts for the Land Mobile Satellite Services (LMSS), namely frequency division (FD) and code division (CD), is presented. Both random access and demand-assigned approaches are considered under these concepts. The CD concept is compared with the traditional FD concept based on the system consideration and a projected traffic model. It is shown that CD is not particularly attractive for the first generation Mobile Satellite Services because of the spectral occupancy of the network bandwidth. However, the CD concept is a viable alternative for future systems such as the personal access satellite system (PASS) in the Ka-band spectrum where spectral efficiency is not of prime concern. The effects of power robbing and voice activity factor are incorporated. It was shown that the traditional rule of thumb of dividing the number of raw channels by the voice activity factor to obtain the effective number of channels is only valid asymptotically as the aggregated traffic approaches infinity. Author

N92-24126*# Rome Univ. (Italy). Dept. of Electronics Engineering.
ADVANCED MULTIPLE ACCESS CONCEPTS IN MOBILE SATELLITE SYSTEMS
Fulvio Ananasso *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 341-345 (For primary document see N92-24071 15-32)
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Some multiple access strategies for Mobile Satellite Systems (MSS) are discussed. These strategies were investigated in the context of three separate studies conducted for the International Maritime Satellite Organization (INMARSAT) and the European Space Agency (ESA). Satellite-Switched Frequency Division Multiple Access (SS-FDMA), Code Division Multiple Access (CDMA), and Frequency-Addressable Beam architectures are addressed, discussing both system and technology aspects and outlining advantages and drawbacks of either solution with associated relevant hardware issues. An attempt is made to compare the considered option from the standpoint of user terminal/space segment complexity, synchronization requirements, spectral efficiency, and interference rejection. Author

N92-24127*# Telecom Research Labs., Clayton (Australia).
SIMULATION OF THE AUSTRALIAN MOBILESAT SIGNALLING SCHEME
Mushfiqur Rahman *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 346-350 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The proposed Australian Mobilesat system will provide a range of circuit switched voice/data services using the B-series satellites. The reliability of the signalling scheme between the Network Management Station (NMS) and the mobile terminal (MT) is of critical importance to the performance of the overall system. Simulation results of the performance of the signalling scheme under various channel conditions and coding schemes are presented. Author

N92-24128*# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Wessling (Germany, F.R.). Inst. for Communications.
RANDOM ACCESS TO MOBILE NETWORKS WITH ADVANCED ERROR CORRECTION
Michael Dippold *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 351-356 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A random access scheme for unreliable data channels is investigated in conjunction with an adaptive Hybrid-II Automatic Repeat Request (ARQ) scheme using Rate Compatible Punctured Codes (RCPC) Forward Error Correction (FEC). A simple scheme with fixed frame length and equal slot sizes is chosen and reservation is implicit by the first packet transmitted randomly in a free slot, similar to Reservation Aloha. This allows the further transmission of redundancy if the last decoding attempt failed. Results show that a high channel utilization and superior throughput can be achieved with this scheme that shows a quite low implementation complexity. For the example of an interleaved Rayleigh channel and soft decision utilization and mean delay are calculated. A utilization of 40 percent may be achieved for a frame with the number of slots being equal to half the station number under high traffic load. The effects of feedback channel errors and some countermeasures are discussed. Author

N92-24129*# Communications Research Centre, Ottawa (Ontario). Dept. of Communications.
SLOPPY-SLOTTED ALOHA
Stewart N. Crozier *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 357-362 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Random access signaling, which allows slotted packets to spill over into adjacent slots, is investigated. It is shown that sloppy-slotted ALOHA can always provide higher throughput than conventional slotted ALOHA. The degree of improvement depends on the timing error distribution. Throughput performance is presented for Gaussian timing error distributions, modified to include timing error corrections. A general channel capacity lower bound, independent of the specific timing error distribution, is also presented. Author

N92-24130*# Chulalongkorn Univ., Bangkok (Thailand).
PERFORMANCE OF RANDOM MULTIPLE ACCESS TRANSMISSION SYSTEM
N. Phinainitisart and W. W. Wu (Stanford Telecommunications, Inc., Reston, VA.) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 363-372 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The performance of the Random Multiple Access (RMA) technique, applied to a direct terminal-to-terminal link with a large number of potential users, is determined. The average signal-to-noise ratio (SNR) is derived. Under Gaussian assumption, the approximation of the probability of error is given. The analysis shows that the system performance is affected by the sequence length, the number of simultaneous users, and the number of cochannel symbols, but is not sensitive to the thermal noise. The performance of using very small aperture antenna for both transmitting and receiving without a hub station is given. Author

N92-24131*# Telesat Canada, Gloucester (Ontario).
SPACE SEGMENT CONFIGURATION OF THE CANADIAN MOBILE SATELLITE SYSTEM Abstract Only
Elemer Bertenyi *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 375 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The performance requirements, the main parameters, and the configuration of the MSAT spacecraft are reviewed. The major features of the communications subsystem are discussed in some detail. Key technology items include the L-band Radio Frequency (RF) power amplifier which must operate with a high DC to RF power efficiency and generate low intermodulation when loaded with multi-carrier signals; and the large diameter deployable L-band antenna. The development status and expected performance of these spacecraft components is examined. Author

N92-24132*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
LLM: AN L-BAND MULTIBEAM LAND MOBILE PAYLOAD FOR EUROPE
J. Benedicto, E. Rammos, G. Oppenhaeuser, and A. Roederer *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 376-383 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The European Space Agency is developing, in the context of the ARTEMIS program, a multibeam reconfigurable mobile payload to provide pre-operational land-mobile satellite services at the L-band over Europe. The L-band Land-Mobile (LLM) payload features high capacity at L-band, efficient use of the L-band spectrum resources, and flexibility in reconfiguring the allocation of bandwith and RF power resources to the different beams. Additionally, a number of features were added to the payload purely for experimental purposes, like the provision of one steerable spot beam which can be repositioned anywhere within the coverage area, and the possibility to reuse L-band frequencies by spatial discrimination between non-adjacent beams, or via orthogonal polarizations. The architecture of the payload and the hardware implementation of the most critical subsystems are described. Author

N92-24133*# Spar Aerospace Ltd., Sainte-Anne-de-Bellevue (Quebec).
THE DESIGN OF A LINEAR L-BAND HIGH POWER AMPLIFIER FOR MOBILE COMMUNICATION SATELLITES
N. Whittaker, G. Brassard, E. Li, and P. Goux *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 384-389 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A linear L-band solid state high power amplifier designed for the space segment of the Mobile Satellite (MSAT) mobile communication system is described. The amplifier is capable of producing 35 watts of RF power with multitone signal at an efficiency of 25 percent and with intermodulation products better than 16 dB below carrier. Author

N92-24134*# Laval Univ. (Quebec).
A METHOD FOR MODELLING PEAK SIGNAL STATISTICS ON A MOBILE SATELLITE TRANSPONDER
Andre Bilodeau, Michel Lecours, Marcel Pelletier, and Gilles Y. Delisle *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 390-393 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A simulation method is proposed. The simulation was developed to model the peak duration and energy content of signal peaks in a mobile communication satellite operating in a Frequency Division Multiple Access (FDMA) mode and presents an estimate of those power peaks for a system where the channels are modeled as band limited Gaussian noise, which is taken as a reasonable representation for Amplitude Commanded Single Sideband (ACSSB), Minimum Shift Keying (MSK), or Phase Shift Keying (PSK) modulated signals. The simulation results show that, under this hypothesis, the level of the signal power peaks for 10 percent, 1 percent, and 0.1 percent of the time are well described by a Rayleigh law and that their duration is extremely short and inversely proportional to the total FDM system bandwidth. Author

N92-24135*# COM DEV Ltd., Cambridge (Ontario).
ENHANCED SPECTRAL EFFICIENCY USING BANDWIDTH SWITCHABLE SAW FILTERING FOR MOBILE SATELLITE COMMUNICATIONS SYSTEMS
Robert Peach and Alastair Malarky *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 394-402 Sponsored in part by the Dept. of Communications, Canada (For primary document see N92-24071 15-32)
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Currently proposed mobile satellite communications systems require a high degree of flexibility in assignment of spectral capacity to different geographic locations. Conventionally this results in poor spectral efficiency which may be overcome by the use of bandwidth switchable filtering. Surface acoustic wave (SAW) technology makes it possible to provide banks of filters whose responses may be contiguously combined to form variable bandwidth filters with constant amplitude and phase responses across the entire band. The high selectivity possible with SAW filters, combined with the variable bandwidth capability, makes it possible to achieve spectral efficiencies over the allocated bandwidths of greater than 90 percent, while retaining full system flexibility. Bandwidth switchable SAW filtering (BSSF) achieves these gains with a negligible increase in hardware complexity. Author

N92-24136*# Ford Aerospace Corp., Palo Alto, CA. Space Systems Div.
ADVANCED COMMUNICATIONS PAYLOAD FOR MOBILE APPLICATIONS
S. A. Ames and R. K. Kwan *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 403-409 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

An advanced satellite payload is proposed for single hop linking of mobile terminals of all classes as well as Very Small Aperture Terminal's (VSAT's). It relies on an intensive use of communications on-board processing and beam hopping for efficient link design to maximize capacity and a large satellite antenna aperture and high satellite transmitter power to minimize the cost of the ground terminals. Intersatellite links are used to improve the link quality and for high capacity relay. Power budgets are presented for links between the satellite and mobile, VSAT, and hub terminals. Defeating the effects of shadowing and fading requires the use of differentially coherent demodulation, concatenated forward error correction coding, and interleaving, all on a single link basis. Author

N92-24137*# Selenia S.p.A., Rome (Italy).
PAYLOADS DEVELOPMENT FOR EUROPEAN LAND MOBILE SATELLITES: A TECHNICAL AND ECONOMICAL ASSESSMENT
G. Perrotta, F. Rispoli, T. Sassorossi, and Selenia Spazio *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 410-416 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The European Space Agency (ESA) has defined two payloads for Mobile Communication; one payload is for pre-operational use, the European Land Mobile System (EMS), and one payload is for promoting the development of technologies for future mobile communication systems, the L-band Land Mobile Payload (LLM). A summary of the two payloads and a description of their capabilities is provided. Additionally, an economic assessment of

the potential mobile communication market in Europe is provided.
Author

N92-24138*# Nippon Electric Co. Ltd., Yokohama (Japan).
A GENERALIZED TRANSMULTIPLEXER AND ITS APPLICATION TO MOBILE SATELLITE COMMUNICATIONS
Osamu Ichiyoshi *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 417-422 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A generalization of digital transmultiplexer technology is presented. The proposed method can realize transmultiplexer (TMUX) and transdemultiplexer (TDUX) filter banks whose element filters have bandwidths greater than the channel spacing frequency. This feature is useful in many communications applications. As an example, a satellite switched (SS) Frequency Division Multiple Access (FDMA) system is proposed for spot beam satellite communications, particularly for mobile satellite communications.
Author

N92-24139*# Spar Aerospace Ltd., Sainte-Anne-de-Bellevue (Quebec).
PAYLOAD SYSTEM TRADEOFFS FOR MOBILE COMMUNICATIONS SATELLITES
H. J. Moody *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 423-427 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

System level trade-offs carried out during Mobile Satellite (M-SAT) design activities are described. These trade-offs relate to the use of low level beam forming, flexible power and spectrum distribution, and selection of the number of beams to cover the service area. It is shown that antenna performance can be improved by sharing horns between beams using a low level beam forming network (BFN). Additionally, greatly increased power utilization is possible using a hybrid matrix concept to share power between beams.
Author

N92-24140*# National Aeronautics and Space Administration, Washington, DC.
US DEVELOPMENT AND COMMERCIALIZATION OF A NORTH AMERICAN MOBILE SATELLITE SERVICE
Ray J. Arnold, Valerie Gray, and Jerry Freibaum (Public Service Satellite Consortium, Washington, DC.) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 431-437 (For primary document see N92-24071 15-32)
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U.S. policies promoting applications and commercialization of space technology for the 'benefit of mankind,' and emphasis on international competitiveness, formed the basis of NASA's Mobile Satellite (MSAT) R&D and user experiments program to develop a commercial U.S. Mobile Satellite Service. Exemplifying this philosophy, the MSAT program targets the reduction of technical, regulatory, market, and financial risks that inhibit commercialization. The program strategy includes industry and user involvement in developing and demonstrating advanced technologies, regulatory advocacy, and financial incentives to industry. Approximately two decades of NASA's satellite communications development and demonstrations have contributed to the emergence of a new multi-billion dollar industry for land, aeronautical, and maritime mobile communications via satellite. NASA's R&D efforts are now evolving from the development of 'enabling' ground technologies for VHF, UHF, and L-Band mobile terminals, to Ka-Band terminals offering additional mobility and user convenience.
Author

N92-24141*# Department of Communications, Ottawa (Ontario). Satellite Applications.
CANADIAN DEVELOPMENT AND COMMERCIALIZATION OF A NORTH AMERICAN MOBILE SATELLITE SERVICE
Demetre Athanassiadis *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 438-443 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Canada recognized early the value of mobile satellite communications, originally through the planning of a military system and subsequently through the development of the Canadian Mobile Satellite (MSAT) systems. Acting on behalf of the government, the Department of Communications (DOC) defined and carried out a complete plan for the implementation of Mobile Satellite Services (MSS). Based on an extensive dialogue between government, industry, and users and encompassing all technical, economic regulatory, and institutional aspects, this plan resulted in the completion by 1986 of a comprehensive business plan and a decision for commercial MSS delivery. The Canadian lead for a commercial system was quickly followed by others, and in particular the U.S., giving rise to the concept of North American MSS.
Author

N92-24142*# Department of Trade and Industry, London (England). Radiocommunications Agency.
DEVELOPMENTS IN LAND MOBILE SATELLITE SERVICE IN EUROPE
D. A. R. Jayasuriya *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 444-449 (For primary document see N92-24071 15-32)
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The evolution of land mobile radio has reached a stage to benefit from satellite communications. The provision of a service on a pan-European basis makes the use of satellites a viable proposition. The paper describes the European position on both system and space segment aspects of the land mobile satellite service. Also, some of the functions of the European institutions, such as the European Telecommunications Standards Institute (ETSI), the Conference of European Postal and Telecommunications Administrations (CEPT), and the Commission of European Communities (CEC), in establishing these services are identified.
Author

N92-24143*# Corporacion Nacional de Radiodeterminacion, Mexico City (Mexico).
IMPLEMENTATION OF MOBILE SATELLITE SERVICES IN DEVELOPING COUNTRIES: THE MEXICAN EXPERIENCE
Alexis Reimers and Jorge Weitzner *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 450-455 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

An analysis of the differences between Developing Countries (DCs) and Industrialized Countries (ICs), in the context of Mobile Satellite Services (MSSs) providers and regulators, is presented. Additionally, a series of recommendations that may improve the odds for a successful implementation of MSSs in DCs are provided.
Author

N92-24144*# Telesat Canada, Gloucester (Ontario).
AN UPWARD COMPATIBLE SPECTRUM SHARING ARCHITECTURE FOR EXISTING, ACTIVELY PLANNED AND EMERGING MOBILE SATELLITE SYSTEMS
Bahman Azarbar *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 456-461 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Existing and actively planned mobile satellite systems are competing for a viable share of the spectrum allocated by the International Telecommunications Union (ITU) to the satellite based mobile services in the 1.5/1.6 GHz range. The limited amount of spectrum available worldwide and the sheer number of existing and planned mobile satellite systems dictate the adoption of an architecture which will maximize sharing possibilities. A viable sharing architecture must recognize the operational needs and

limitations of the existing systems. Furthermore, recognizing the right of access of the future systems as they will emerge in time, the adopted architecture must allow for additional growth and be amenable to orderly introduction of future systems. An attempt to devise such a sharing architecture is described. A specific example of the application of the basic concept to the existing and planned mobile satellite systems is also discussed. Author

N92-24145*# Gurman, Kurtis, Blask and Freedman Chartered, Washington, DC.
MOBILE SATELLITE REGULATION IN THE UNITED STATES
Lon C. Levin and Walter H. Sonnenfeldt *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 463-467 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

During the last decade, the U.S. FCC has developed the regulatory structure for the provision of mobile services via satellite. In May 1989, the FCC awarded American Mobile Satellite Corporation (AMSC) a license to provide the full range of domestic mobile satellite services in the U.S. At that time, the FCC reaffirmed the U.S. mobile satellite industry structure and spectrum allocations that had been adopted previously. Also in May 1989, the FCC authorized the Communications Satellite Corporation (COMSAT), the U.S. Signatory to Inmarsat, to provide international aeronautical satellite service via the Inmarsat system. Earlier in 1989, the FCC permitted the use of Ku-band satellites to provide messaging and tracking services. In the mid-1980's, the FCC established the Radiodetermination Satellite Service and awarded licenses. Among the mobile satellite matters currently facing the FCC are whether additional spectrum should be allocated for domestic 'generic' mobile satellite services, the regulatory structure for the provision of mobile satellite service on an interim basis before AMSC launches its dedicated satellites, and whether to authorize a low earth orbit satellite system to provide mobile data service. Author

N92-24146*# Department of Communications, Ottawa (Ontario). Telecommunications Policy Branch.
REVIEW OF CANADIAN MOBILE SATELLITE SYSTEMS INSTITUTIONAL ARRANGEMENTS POLICY
David Gilvary *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 468-472 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Development of institutional arrangements policy for maritime, land, and aeronautical mobile satellite systems (MSS) is an integral part of the Canadian telecommunications policy process. An ongoing activity in that process is fitting of MSS institutional arrangements policy within the confines of the 1987 Canadian Telecom Policy Framework. Making sure the fit is correct is a major task at present because technology seems to be driving service demand at rapid growth rates, particularly in the case of land MSS. This growth is stimulating policy and regulatory development efforts to keep pace. In Canada, this is happening in four planned MSS applications areas: Canada-US transborder (immediate), aeronautical MSS (1990/94), Telesat Mobile Inc. EMDS via INMARSAT (1990), and MSAT (1993/94). The need for an up-to-date MSS policy in these areas is emphasized by related developments in the US and elsewhere. It arises because of the growing number of market initiatives proposing North American rather than Canada-only or US-only coverage, such as INMARSAT, Geostar, OmniTRACS, and Starlink. Author

N92-24147*# Geostar Messaging Corp., Washington, DC.
LICENSING OF FUTURE MOBILE SATELLITE SYSTEMS
Ronald J. Lepkowski *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 473-477 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The regulatory process for licensing mobile satellite systems is complex and can require many years to complete. This process involves frequency allocations, national licensing, and frequency coordination. The regulatory process that resulted in the establishment of the radiodetermination satellite service (RDSS) between 1983 and 1987 is described. In contrast, each of these steps in the licensing of the mobile satellite service (MSS) is taking a significantly longer period of time to complete. Author

N92-24148*# Department of Communications, Ottawa (Ontario). Space Services Frequency.
A NEW LICENSING STRATEGY FOR CANADIAN MOBILE EARTH STATIONS Abstract Only
Ronald G. Amero *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 478 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Initiatives presently under consideration by the Department of Communications which will greatly simplify the licensing process for mobile earth stations are addressed. The current licensing approach is reviewed and the limitations of that system identified. A new approach is needed to respond to the needs of mobile satellite users in the 1990's and beyond, one which will have a minimal impact on the user while still respecting the legislative responsibilities of the department under the new Radiocommunication Act and the General Radio Regulations. The objective of this new strategy is to lead to a transparent licensing scheme for the end user, which in turn could lead to license exemption of blanket licenses as soon as possible. Author

N92-24149*# Sydney Univ. (Australia). School of Electrical Engineering.
NEW 16-PSK TRELLIS CODES FOR FADING CHANNELS
Jun Du, Branka Vucetic, and Lin Zhang *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 481-486 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Growth in satellite mobile communications leads to increasing requirements for high data rate transmission that can be met by more efficient modulation schemes (M greater than 8). The 16-PSK trellis coded modulation technique is a very promising solution. A class of new 16-PSK trellis codes with improved error rate are designed based on the criteria on fading channels. Author

N92-24150*# Ottawa Univ. (Ontario). Electrical Engineering.
POWER AND SPECTRALLY EFFICIENT M-ARY QAM SCHEMES FOR FUTURE MOBILE SATELLITE COMMUNICATIONS
K. Sreenath and K. Feher (California Univ., Davis.) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 487-492 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

An effective method to compensate nonlinear phase distortion caused by the mobile amplifier is proposed. As a first step towards the future use of spectrally efficient modulation schemes for mobile satellite applications, we have investigated effects of nonlinearities and the phase compensation method on 16-QAM. The new method provides about 2 dB savings in power for 16-QAM operation with cost effective amplifiers near saturation and thereby promising use of spectrally efficient linear modulation schemes for future mobile satellite applications. Author

N92-24151*# Rensselaer Polytechnic Inst., Troy, NY. Electrical, Computer and Systems Engineering.
A TONE-AIDED/DUAL VESTIGIAL SIDEBAND (TA/DVSB) SYSTEM FOR MOBILE SATELLITE CHANNELS
Gary J. Saulnier, Gilbert M. Millar, and Anthony D. dePaolo *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 493-498 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Tone-aided modulation is one way of combatting the effects

of multipath fading and Doppler frequency shifts. A new tone-aided modulation format for M-ary phase-shift keyed signals (MPSK) is discussed. A spectral null for the placement of the tone is created in the center of the MPSK signal by translating the upper sideband upwards in frequency by the same amount. The key element of the system is the algorithm for recombining the data sidebands in the receiver, a function that is performed by a specialized phase-locked loop (PLL). The system structure is discussed and simulation results showing the PLL acquisition performance are presented. Author

N92-24152*# London Univ. (England). Dept. of Electrical and Electronic Engineering.

SYNCHRONIZATION TECHNIQUES FOR ALL DIGITAL 16-ARY QAM RECEIVERS OPERATING OVER LAND MOBILE SATELLITE LINKS

P. Fines and A. H. Aghvami *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 499-504 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The performance of a low bit rate (64 Kb/s) all digital 16-ary Differentially Encoded Quadrature Amplitude Modulation (16-DEQAM) demodulator operating over a mobile satellite channel, is considered. The synchronization and detection techniques employed to overcome the Rician channel impairments, are described. The acquisition and steady state performance of this modem, are evaluated by computer simulation over AWGN and RICIAN channels. The results verify the suitability of the 16-DEQAM transmission over slowly faded and/or mildly faded channels. Author

N92-24153*# Sydney Univ. (Australia). Dept. of Electrical Engineering.

CARRIER RECOVERY TECHNIQUES ON SATELLITE MOBILE CHANNELS

B. Vucetic and J. Du *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 505-510 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

An analytical method and a stored channel model were used to evaluate error performance of uncoded quadrature phase shift keying (QPSK) and M-ary phase shift keying (MPSK) trellis coded modulation (TCM) over shadowed satellite mobile channels in the presence of phase jitter for various carrier recovery techniques. Author

N92-24154*# Nippon Electric Co. Ltd., Kawasaki (Japan). C and C System Research Labs.

PERFORMANCE EVALUATION OF A MOBILE SATELLITE SYSTEM MODEM USING AN ALE METHOD

Tomoki Ohsawa and Motoya Iwasaki (Nippon Electric Co. Ltd., Yokohama, Japan) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 511-515 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Experimental performance of a newly designed demodulation concept is presented. This concept applies an Adaptive Line Enhancer (ALE) to a carrier recovery circuit, which makes pull-in time significantly shorter in noisy and large carrier offset conditions. This new demodulation concept was actually developed as an INMARSAT standard-C modem, and was evaluated. On a performance evaluation, 50 symbol pull-in time is confirmed under 4 dB Eb/No condition. Author

N92-24155*# Ministry of Posts and Telecommunications, Kashima (Japan). Communications Research Lab.

A PHASED ARRAY TRACKING ANTENNA FOR VEHICLES

Shingo Ohmori, Kazukiko Mano, Kenji Tanaka, Makoto Matsunaga, and Makio Tsuchiya (Mitsubishi Electric Corp., Amagasaki, Japan) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 519-522 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

An antenna system including antenna elements and a satellite tracking method is considered a key technology in implementing land mobile satellite communications. In the early stage of land mobile satellite communications, a mechanical tracking antenna system is considered the best candidate for vehicles, however, a phased array antenna will replace it in the near future, because it has many attractive advantages such as a low and compact profile, high speed tracking, and potential low cost. Communications Research Laboratory is now developing a new phased array antenna system for land vehicles based on research experiences of the airborne phased array antenna, which was developed and evaluated in satellite communication experiments using the ETS-V satellite. The basic characteristics of the phased array antenna for land vehicles are described. Author

N92-24156*# Manitoba Univ., Winnipeg. Dept. of Electrical and Computer Engineering.

MSAT VEHICULAR ANTENNAS WITH SELF SCANNING ARRAY ELEMENTS

L. Shafai *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 523-528 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A new approach for designing low profile antennas for MSAT applications is presented. It is based on stacking two microstrip antennas that operate at two adjacent modes. The beam scanning is achieved by introducing a phase shift between the stacked elements and consequently a low cost self scan array element is developed. The concept is used to investigate two different antenna types: (1) a single element unit, with its phase shifter, that provides a moderate gain of about 7 dBic; and (2) a seven element array with a peak gain of about 14 dBic. Computed and measured data for each design are presented and discussed. Author

N92-24157*# Communications Research Centre, Ottawa (Ontario). Communications Canada.

AN ADAPTIVE ARRAY ANTENNA FOR MOBILE SATELLITE COMMUNICATIONS

Robert Milne *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 529-534 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The design of an adaptive array antenna for land vehicle operation and its performance in an operational satellite system is described. Linear and circularly polarized antenna designs are presented. The acquisition and tracking operation of a satellite is described and the effect on the communications signal is discussed. A number of system requirements are examined that have a major impact on the antenna design. The results of environmental, power handling, and RFI testing are presented and potential problems are identified. Author

N92-24158*# Bristol Univ. (England). Centre for Communications Research.

STANDARD-M MOBILE SATELLITE TERMINAL EMPLOYING ELECTRONIC BEAM SQUINT TRACKING

G. J. Hawkins, M. A. Beach, and G. S. Hilton *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 535-539 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

In recent years, extensive experience has been built up at the University of Bristol in the use of the Electronic Beam Squint (EBS) tracking technique, applied to large earth station facilities. The current interest in land mobile satellite terminals, using small tracking antennas, has prompted the investigation of the applicability of the EBS technique to this environment. The development of an L-band mechanically steered vehicle antenna is presented. A description of the antenna is followed by a detailed

investigation of the tracking environment and its implications on the error detection capability of the system. Finally, the overall hardware configuration is described along with plans for future work. Author

N92-24159*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PERFORMANCE OF A FAMILY OF OMNI AND STEERED ANTENNAS FOR MOBILE SATELLITE APPLICATIONS
K. Woo, J. Huang, V. Jamnejad, D. Bell, J. Berner, P. Estabrook, and A. Densmore *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 540-546 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The design and performance of a family of vehicle antennas developed at JPL in support of an emerging US Mobile Satellite Service (MSS) system are described. Test results of the antennas are presented. Trends for future development are addressed. Recommendations on design approaches for vehicle antennas of the first generation MSS are discussed. Author

N92-24160*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN ANSERLIN ARRAY FOR MOBILE SATELLITE APPLICATIONS
F. Y. Colomb, D. B. Kunkee, P. E. Mayes, D. W. Smith (Illinois Univ., Urbana.), and V. Jamnejad *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 547-553 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Design, analysis, construction, and test of linear arrays of ANSERLIN (annular sector, radiating line) elements are reported and discussed. Due to feeding simplicity and easy construction as well as good CP performance, a planar array composed of a number of such linear arrays each producing a shaped beam tilted in elevation, is a good candidate as a vehicle-mounted mechanically steered antenna for mobile satellite applications. A single level construction technique was developed that makes this type of array very cost competitive with other low-profile arrays. An asymmetric 19.5 inch long four-element array was fabricated and tested with reasonable performance. A smaller five-element symmetric array (16 inch long) was also designed and tested capable of operating in either sense of circular polarization. Efforts were made to successfully reduce this effect. Author

N92-24161*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MICROSTRIP YAGI ARRAY FOR MSAT VEHICLE ANTENNA APPLICATION
John Huang, Arthur Densmore, and David Pozar (Massachusetts Univ., Amherst.) *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 554-559 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A microstrip Yagi array was developed for the MSAT system as a low-cost mechanically steered medium-gain vehicle antenna. Because its parasitic reflector and director patches are not connected to any of the RF power distributing circuit, while still contributing to achieve the MSAT required directional beam, the antenna becomes a very efficient radiating system. With the complete monopulse beamforming circuit etched on a thin stripline board, the planar microstrip Yagi array is capable of achieving a very low profile. A theoretical model using the Method of Moments was developed to facilitate the ease of design and understanding of this antenna. Author

N92-24162*# Bristol Univ. (England). Faculty of Engineering.
THE ANALYSIS OF REACTIVELY LOADED MICROSTRIP ANTENNAS BY FINITE DIFFERENCE TIME DOMAIN MODELLING
G. S. Hilton, M. A. Beach, and C. J. Railton *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 560-565 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

In recent years, much interest has been shown in the use of printed circuit antennas in mobile satellite and communications terminals at microwave frequencies. Although such antennas have many advantages in weight and profile size over more conventional reflector/horn configurations, they do, however, suffer from an inherently narrow bandwidth. A way of optimizing the bandwidth of such antennas by an electronic tuning technique using a loaded probe mounted within the antenna structure is examined, and the resulting far-field radiation patterns are shown. Simulation results from a 2D finite difference time domain (FDTD) model for a rectangular microstrip antenna loaded with shorting pins are given and compared to results obtained with an actual antenna. It is hoped that this work will result in a design package for the analysis of microstrip patch antenna elements. Author

N92-24163*# Federal Aviation Administration, Washington, DC.
SYSTEM CONSIDERATIONS, PROJECTED REQUIREMENTS AND APPLICATIONS FOR AERONAUTICAL MOBILE SATELLITE COMMUNICATIONS FOR AIR TRAFFIC SERVICES Abstract Only
K. D. McDonald, C. M. Miller, W. C. Scales, and D. K. Dement *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 569 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The projected application and requirements in the near term (to 1995) and far term (to 2010) for aeronautical mobile services supporting air traffic control operations are addressed. The implications of these requirements on spectrum needs, and the resulting effects on the satellite design and operation are discussed. The U.S. is working with international standards and regulatory organizations to develop the necessary aviation standards, signalling protocols, and implementation methods. In the provision of aeronautical safety services, a number of critical issues were identified, including system reliability and availability, access time, channel restoration time, interoperability, pre-emption techniques, and the system network interfaces. Means for accomplishing these critical services in the aeronautical mobile satellite service (AMSS), and the various activities relating to the future provision of aeronautical safety services are addressed. Author

N92-24164*# Transport Canada Aviation, Ottawa (Ontario).
AERONAUTICAL MOBILE SATELLITE SERVICE: AIR TRAFFIC CONTROL APPLICATIONS
Dave Sim *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 570-574 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Canada's history both in aviation and in satellite communications development spans several decades. The introduction of aeronautical mobile satellite communications will serve our requirements for airspace management in areas not served by line-of-sight radio and radar facilities. The ensuing improvements in air safety and operating efficiency are eagerly awaited by the aviation community. Author

N92-24165*# Anderson Associates, Glenville, NY.
SPECTRUM SHARING BETWEEN AMSS(R) AND MSS
Roy E. Anderson *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 575-578 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Generic satellite systems will serve aeronautical, land, and maritime users in the US and Canada. One important service, the Aeronautical Mobile Satellite (Route) Service (AMS(R)S), pertains to the safety and regularity of flight. The North American systems are designed to assure that this vital safety service is not impaired in any way as it shares the spectrum and satellites with a large number and great variety of other users in other services. Two of

the topics discussed are AMS(R)S requirements and AMS(R)S operation through American Mobile Satellite Corporation (AMSC) Satellites. Author

N92-24166*# Communications Research Centre, Ottawa (Ontario). Mobile Terminal Development.

RECENT TECHNICAL ADVANCES IN GENERAL PURPOSE MOBILE SATCOM AVIATION TERMINALS

John T. Sydor *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 579-586 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A second general aviation amplitude companded single sideband (ACSSB) aeronautical terminal was developed for use with the Ontario Air Ambulance Service (OAAS). This terminal is designed to have automatic call set up and take down and to interface with the Public Service Telephone Network (PSTN) through a ground earth station hub controller. The terminal has integrated RF and microprocessor hardware which allows such functions as beam steering and automatic frequency control to be software controlled. The terminal uses a conformal patch array system to provide almost full azimuthal coverage. Antenna beam steering is executed without relying on aircraft supplied orientation information. Author

N92-24167*# International Maritime Satellite Organization, London (England).

FUTURE DEVELOPMENTS IN AERONAUTICAL SATELLITE COMMUNICATIONS

Peter Wood *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 587-592 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Very shortly aeronautical satellite communications will be introduced on a world wide basis. By the end of the year, voice communications (both to the cabin and cockpit) and packet data communications will be available to both airlines and executive aircraft. During the decade following the introduction of the system, there will be many enhancements and developments which will increase the range of applications, expand the potential number of users, and reduce costs. A number of ways in which the system is expected to evolve over this period are presented. Among the issues which are covered are the impact of spot beam satellites, spectrum and power conservation techniques, and the expanding range of user services. Author

N92-24168*# ELAB-RUNIT, Trondheim (Norway).

CONSIDERATIONS OF DIGITAL PHASE MODULATION FOR NARROWBAND SATELLITE MOBILE COMMUNICATION

Knut Grythe *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 595-599 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The Inmarsat-M system for mobile satellite communication is specified as a frequency division multiple access (FDMA) system, applying Offset Quadrature Phase Shift Keying (QPSK) for transmitting 8 kbit/sec in 10 kHz user channel bandwidth. We consider Digital Phase Modulation (DPM) as an alternative modulation format for INMARSAT-M. DPM is similar to Continuous Phase Modulation (CPM) except that DPM has a finite memory in the premodular filter with a continuous varying modulation index. It is shown that DPM with 64 states in the VA obtains a lower bit error rate (BER). Results for a 5 kHz system, with the same 8 kbit/sec transmitted bitstream, is also presented. Author

N92-24169*# Communications Research Centre, Ottawa (Ontario).

PERFORMANCE OF CONCATENATED REED-SOLOMON TRELLIS-CODED MODULATION OVER RICIAN FADING CHANNELS

Michael L. Moher and John H. Lodge *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 600-604 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A concatenated coding scheme for providing very reliable data over mobile-satellite channels at power levels similar to those used for vocoded speech is described. The outer code is a shorter Reed-Solomon code which provides error detection as well as error correction capabilities. The inner code is a 1-D 8-state trellis code applied independently to both the inphase and quadrature channels. To achieve the full error correction potential of this inner code, the code symbols are multiplexed with a pilot sequence which is used to provide dynamic channel estimation and coherent detection. The implementation structure of this scheme is discussed and its performance is estimated. Author

N92-24170*# California Univ., Davis. Digital Communications Research Lab.

A NOVEL SCHEME TO AID COHERENT DETECTION OF GMSK SIGNALS IN FAST RAYLEIGH FADING CHANNELS

Patrick S. K. Leung and Kamilo Feher *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 605-611 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A novel scheme to insert carrier pilot to Gaussian Minimum Shift Keying (GMSK) signal using Binary Block Code (BBC) and a highpass filter in baseband is proposed. This allows the signal to be coherently demodulated even in a fast Rayleigh fading environment. As an illustrative example, the scheme is applied to a 16 kb/s GMSK signal, and its performance over a fast Rayleigh fading channel is investigated using computer simulation. This modem's 'irreducible error rate' is found to be Pe = 5.5 x 10(exp -5) which is more than that of differential detection. The modem's performance in Rician fading channel is currently under investigation. Author

N92-24171*# Bristol Univ. (England). Centre for Communications Research.

ANALOGUE AND DIGITAL LINEAR MODULATION TECHNIQUES FOR MOBILE SATELLITE

W. J. Whitmarsh, A. Bateman, and J. P. McGeehan *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 612-616 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The choice of modulation format for a mobile satellite service is complex. The subjective performance is summarized of candidate schemes and voice coder technologies. It is shown that good performance can be achieved with both analogue and digital voice systems, although the analogue system gives superior performance in fading. The results highlight the need for flexibility in the choice of signaling format. Linear transceiver technology capable of using many forms of narrowband modulation is described. Author

N92-24172*# Telesat Mobile, Inc., Ottawa (Ontario).

MSAT VOICE MODULATION CONSIDERATIONS

Dan Bossler *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 617-621 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The challenge for Mobile satellite (MSAT) voice services is to provide near toll quality voice to the user, while minimizing the power and bandwidth resources of the satellite. The options for MSAT voice can be put into one of two groups: Analog and Digital. Analog, nominally narrowband single sideband techniques, have a shown robustness to the fading and shadowing environment. Digital techniques, a combination of low rate vocoders and bandwidth efficient modems, show the promise of enhanced fidelity, as well as easier networking to the emerging digital world. The problems and tradeoffs to designers are many, especially in the digital case.

Processor speed vs. cost and MET power requirements, channel coding, bandwidth efficiency vs. power efficiency etc. While the list looks daunting, in fact an acceptable solution is well within the technology. The objectives are reviewed that the MSAT voice service must meet, along with the options that are seen for the future. Author

N92-24173*# Nippon Electric Co. Ltd., Kawasaki (Japan). C and C Systems Research Labs.

A NEW COHERENT DEMODULATION TECHNIQUE FOR LAND-MOBILE SATELLITE COMMUNICATIONS

Shousei Yoshida and Hideho Tomita *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 622-627 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

An advanced coherent demodulation technique is described for land mobile satellite (LMS) communications. The proposed technique features a combined narrow/wind band dual open loop carrier phase estimator, which is effectively able to compensate the fast carrier phase fluctuation by fading with sacrificing a phase slip rate. Also included is the realization of quick carrier and clock reacquisition after shadowing by taking open loop structure. Its bit error rate (BER) performance is superior to that of existing detection schemes, showing a BER of 1 x 10(exp -2) at 6.3 dB E sub b/N sub o over the Rician channel with 10 dB C/M and 200 Hz (1/16 modulation rate) fading pitch f sub d for QPSK. The proposed scheme consists of a fast response carrier recovery and a quick bit timing recovery with an interpolation. An experimental terminal model was developed to evaluate its performance at fading conditions. The results are quite satisfactory, giving prospects for future LMS applications. Author

N92-24174*# South Australian Inst. of Tech., Ingle Farm. Digital Communications Group.

MODEM DESIGN FOR A MOBILESAT TERMINAL

M. Rice, M. J. Miller, W. G. Cowley, and D. Rowe *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 628-632 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The implementation is described of a programmable digital signal processor based system, designed for use as a test bed in the development of a digital modem, codec, and channel simulator. Code was written to configure the system as a 5600 bps or 6600 bps QPSK modem. The test bed is currently being used in an experiment to evaluate the performance of digital speech over shadowed channels in the Australian mobile satellite (MOBILESAT) project. Author

N92-24175*# Rockwell International Corp., Cedar Rapids, IA. Mobile Communication Satellite System.

FREQUENCY-OFFSET INSENSITIVE DIGITAL MODEM TECHNIQUES

S. Dutta and D. C. Nicholas *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 633-638 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Conventional DPSK systems are adversely affected by transmitter/receiver frequency offsets due to frequency reference errors and Doppler shifts. Two DPSK modem concepts are presented which avoid the long frequency acquisition process of conventional DPSK. One technique involves a modified demodulator for conventional DPSK signals, while the other involves making minor changes to both the modulator and demodulator. Simulation results are provided showing performance relative to conventional DPSK. Author

N92-24176*# Ottawa Univ. (Ontario). Dept. of Electrical Engineering.

COMPARISON OF FDMA AND CDMA FOR SECOND GENERATION LAND-MOBILE SATELLITE COMMUNICATIONS

A. Yongacoglu, R. G. Lyons, and B. A. Mazur (Calian Communications, Kanata, Ontario) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 639-644 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Code Division Multiple Access (CDMA) and Frequency Division Multiple Access (FDMA) (both analog and digital) systems capacities are compared on the basis of identical link availabilities and physical propagation models. Parameters are optimized for a bandwidth limited, multibeam environment. For CDMA, the benefits of voice activated carriers, antenna discrimination, polarization reuse, return link power control and multipath suppression are included in the analysis. For FDMA, the advantages of bandwidth efficient modulation/coding combinations, voice activated carriers, polarization reuse, beam placement, and frequency staggering were taken into account. Author

N92-24177*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

PERFORMANCE OF A LOW DATA RATE SPEECH CODEC FOR LAND-MOBILE SATELLITE COMMUNICATIONS

Allen Gersho (Voicecraft, Inc., Goleta, CA.) and Thomas C. Jedrey *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 647-653 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

In an effort to foster the development of new technologies for the emerging land mobile satellite communications services, JPL funded two development contracts in 1984: one to the Univ. of Calif., Santa Barbara and the other to the Georgia Inst. of Technology, to develop algorithms and real time hardware for near toll quality speech compression at 4800 bits per second. Both universities have developed and delivered speech codecs to JPL, and the UCSB codec was extensively tested by JPL in a variety of experimental setups. The basic UCSB speech codec algorithms and the test results of the various experiments performed with this codec are presented. Author

N92-24178*# MPR Teltech Ltd., Burnaby (British Columbia).

MASKING OF ERRORS IN TRANSMISSION OF VAPC-CODED SPEECH

Neil B. Cox and Edwin L. Froese *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 654-660 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A subjective evaluation is provided of the bit error sensitivity of the message elements of a Vector Adaptive Predictive (VAPC) speech coder, along with an indication of the amenability of these elements to a popular error masking strategy (cross frame hold over). As expected, a wide range of bit error sensitivity was observed. The most sensitive message components were the short term spectral information and the most significant bits of the pitch and gain indices. The cross frame hold over strategy was found to be useful for pitch and gain information, but it was not beneficial for the spectral information unless severe corruption had occurred. Author

N92-24179*# Bell Telephone Labs., Inc., Murray Hill, NJ.

A ROBUST CELP CODER WITH SOURCE-DEPENDENT CHANNEL CODING

Rafid A. Sukkar and W. Bastiaan Kleijn *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 661-666 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A CELP coder using Source Dependent Channel Encoding (SDCE) for optimal channel error protection is introduced. With SDCE, each of the CELP parameters are encoded by minimizing a perceptually meaningful error criterion under prevalent channel conditions. Unlike conventional channel coding schemes, SDCE allows for optimal balance between error detection and correction.

The experimental results show that the CELP system is robust under various channel bit error rates and displays a graceful degradation in SSNR as the channel error rate increases. This is a desirable property to have in a coder since the exact channel conditions cannot usually be specified a priori. Author

N92-24180*# Carleton Univ., Ottawa (Ontario).
STRUCTURED CODEBOOK DESIGN IN CELP
W. P. LeBlanc and S. A. Mahmoud *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 667-672 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Codebook Excited Linear Protection (CELP) is a popular analysis by synthesis technique for quantizing speech at bit rates from 4 to 6 kbps. Codebook design techniques to date have been largely based on either random (often Gaussian) codebooks, or on known binary or ternary codes which efficiently map the space of (assumed white) excitation codevectors. It has been shown that by introducing symmetries into the codebook, good complexity reduction can be realized with only marginal decrease in performance. Codebook design algorithms are considered for a wide range of structured codebooks. Author

N92-24181*# Communications Research Centre, Ottawa (Ontario). Dept. of Communications.
A 4800 BPS CELP VOCODER WITH AN IMPROVED EXCITATION
Hisham Hassanein, Andre BrindAmour, and Karen Bryden *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 673-677 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The Stochastic or Code Excited Linear Predictive Coder (CELP) is among the promising candidates for producing good quality speech at low bit rates. However, the speech quality produced suffers from perceived roughness. Many researchers have used pole-zero postfilters to mask the roughness at the output of the synthesis filter. Although the postfilters are effective in masking the noise at low bit rates, they produce spectral distortions. It is proposed that speech can be improved by introducing two modifications to the fixed stochastic codebook. In the first modification, the stochastic codebook is used only when the long term correlations are low. Otherwise, a pulse like codebook is selected. In the second modification, the selected codebook output is weighted using an adaptive spectral shaping procedure. These two modifications were incorporated in a 4800 bps CELP coder and have resulted in a perceptually improved vocoded speech. Author

N92-24182*# Motorola, Inc., Schaumburg, IL. Chicago Corporate Research and Development Center.
VECTOR SUM EXCITED LINEAR PREDICTION (VSELP) SPEECH CODING AT 4.8 KBPS
Ira A. Gerson and Mark A. Jasiuk *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 678-683 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Code Excited Linear Prediction (CELP) speech coders exhibit good performance at data rates as low as 4800 bps. The major drawback to CELP type coders is their larger computational requirements. The Vector Sum Excited Linear Prediction (VSELP) speech coder utilizes a codebook with a structure which allows for a very efficient search procedure. Other advantages of the VSELP codebook structure is discussed and a detailed description of a 4.8 kbps VSELP coder is given. This coder is an improved version of the VSELP algorithm, which finished first in the NSA's evaluation of the 4.8 kbps speech coders. The coder uses a subsample resolution single tap long term predictor, a single VSELP excitation codebook, a novel gain quantizer which is robust to channel errors, and a new adaptive pre/postfilter arrangement. Author

N92-24183*# Carleton Univ., Ottawa (Ontario). Dept. of Systems and Computer Engineering.
A LOW-DELAY 8 Kb/s BACKWARD-ADAPTIVE CELP CODER
L. G. Neumeyer, W. P. LeBlanc, and S. A. Mahmoud *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 684-689 Sponsored in part by Telecommunication Research Inst. of Ottawa (TRIO) (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Code excited linear prediction coding is an efficient technique for compressing speech sequences. Communications quality of speech can be obtained at bit rates below 8 Kb/s. However, relatively large coding delays are necessary to buffer the input speech in order to perform the LPC analysis. A low delay 8 Kb/s CELP coder is introduced in which the short term predictor is based on past synthesized speech. A new distortion measure that improves the tracking of the formant filter is discussed. Formal listening tests showed that the performance of the backward adaptive coder is almost as good as the conventional CELP coder. Author

N92-24184*# Surrey Univ., Guildford (England). Dept. of Electronics and Electrical Engineering.
A VARIABLE RATE SPEECH COMPRESSOR FOR MOBILE APPLICATIONS
S. Yeldener, A. M. Kondoz, and B. G. Evans *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 690-695 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

One of the most promising speech coder at the bit rate of 9.6 to 4.8 kbits/s is CELP. Code Excited Linear Prediction (CELP) has been dominating 9.6 to 4.8 kbits/s region during the past 3 to 4 years. Its set back however, is its expensive implementation. As an alternative to CELP, the Base-Band CELP (CELP-BB) was developed which produced good quality speech comparable to CELP and a single chip implementable complexity as reported previously. Its robustness was also improved to tolerate errors up to 1.0 pct. and maintain intelligibility up to 5.0 pct. and more. Although, CELP-BB produces good quality speech at around 4.8 kbits/s, it has a fundamental problem when updating the pitch filter memory. A sub-optimal solution is proposed for this problem. Below 4.8 kbits/s, however, CELP-BB suffers from noticeable quantization noise as a result of the large vector dimensions used. Efficient representation of speech below 4.8 kbits/s is reported by introducing Sinusoidal Transform Coding (STC) to represent the LPC excitation which is called Sine Wave Excited LPC (SWELP). In this case, natural sounding good quality synthetic speech is obtained at around 2.4 kbits/s. Author

N92-24185*# Telecom Research Labs., Clayton (Australia).
EVALUATION OF VOICE CODECS FOR THE AUSTRALIAN MOBILE SATELLITE SYSTEM
Tony Bundrock and Mal Wilkinson *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 696-699 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The evaluation procedure to choose a low bit rate voice coding algorithm is described for the Australian land mobile satellite system. The procedure is designed to assess both the inherent quality of the codec under 'normal' conditions and its robustness under 'severe' conditions. For the assessment, normal conditions were chosen to be random bit error rate with added background acoustic noise and the severe condition is designed to represent burst error conditions when mobile satellite channel suffers from signal fading due to roadside vegetation. The assessment is divided into two phases. First, a reduced set of conditions is used to determine a short list of candidate codecs for more extensive testing in the second phase. The first phase conditions include quality and robustness and codecs are ranked with a 60:40 weighting on the two. Second, the short listed codecs are assessed over a range of input voice levels, BERs, background noise

conditions, and burst error distributions. Assessment is by subjective rating on a five level opinion scale and all results are then used to derive a weighted Mean Opinion Score using appropriate weights for each of the test conditions. Author

N92-24186*# Telesat Mobile, Inc., Ottawa (Ontario).
MSAT AN ALTERNATIVE CHOICE?
K. E. Fagan and C. Elmer *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 703-706 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A number of potential applications are described of MSAT that use the unique properties of this transportation mechanism. Emphasis is placed on the market introduction strategy for the North American system. Author

N92-24187*# American Mobile Satellite Corp., Washington, DC.
USER APPLICATIONS UNIQUE TO MOBILE SATELLITES
David Castiel *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 707-711 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

As AMSC enters the market with its mobile satellite services, it faces a sophisticated user group that has already experimented with a wide range of communications services, including cellular radio and Ku-band satellite messaging. AMSC's challenge is to define applications unique to the capabilities of its dedicated L band satellite and consistent with the provisions outlined in its FCC license. Through a carefully researched approach to its three main markets (aeronautical, land mobile, and maritime) AMSC is discovering a wellspring of interest in corporate and general aviation, trucking companies, pipeline monitoring and control companies, maritime management firms, telecommunications companies, and government agencies. A general overview is provided of AMSC's FCC license and corporate history, and the specific applications unique to each user group is discussed. Author

N92-24188*# Bell Canada Enterprises Mobile, Inc., Sainte-Laurent (Quebec).
MSAT: A BOOSTER FOR LAND BASED MOBILE RADIOCOMMUNICATION NETWORKS?
Guy Boulay *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 712-716 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

It is demonstrated that the foreseen phenomenal growth of mobilesat services will impact positively existing terrestrial mobile radio services. Mobilesat systems will not displace the existing terrestrial market in the near future, partly due to the high cost of their terminal units and associated airtime, but also due to some technical limitations, such as lack of spectrum efficiency and high susceptibility to shadowing. However, the ubiquity of mobilesat services will open new market to terrestrial radio technologies. The latter is expected to be the most economical way of extending locally mobilesat services to many users. Conversely, mobilesat systems will be used to extend the capabilities of terrestrial radio systems in areas where the former cannot be implemented cost effectively. It is believed that terrestrial mobile network operators using these service extension capabilities will have a competitive advantage over those who do not. Overall, it is expected that emerging mobilesat services, far from being a threat to terrestrial radio systems, will rather provide these with numerous opportunities of incrementing their base market. Author

N92-24189*# Communications Research Centre, Ottawa (Ontario). MSAT Trials Planning.
CANADIAN MSAT FIELD TRIAL PROGRAM USER REQUIREMENTS
Allister Pedersen *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 717-722 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A wide range of mobile satellite service offerings will be available in late 1993 with the launch of Canada's first satellite devoted almost exclusively to mobile and transportable services. During the last seven years, the Dept. of Communications has been meeting with potential MSAT users in government and the private sector as part of a $20M Communications Trials Program. User trials will be conducted using leased capacity as well as capacity on Canada's MSAT satellite. User requirements are discussed which were identified under the Communications Trials Program. Land, marine, aeronautical, and fixed applications are described from the perspective of the end users. Emphasis is placed on field trials being accomplished using leased capacity such as the marine data trial being implemented by Ultimateast Data Communications, trials using transportable briefcase terminals and additional field trials being considered for implementation with the TMI Mobile Data Service. The pre-MSAT trials that will be conducted using leased capacity are only a limited sample of the overall end user requirements that have been identified to date. Additional end user applications are discussed, along with a summary of user benefits. Author

N92-24190*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SECURE VOICE FOR MOBILE SATELLITE APPLICATIONS
Arvydas Vaisnys and Jeff Berner *In its* Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 723-728 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The initial system studies are described which were performed at JPL on secure voice for mobile satellite applications. Some options are examined for adapting existing Secure Telephone Unit III (STU-III) secure telephone equipment for use over a digital mobile satellite link, as well as for the evolution of a dedicated secure voice mobile earth terminal (MET). The work has included some lab and field testing of prototype equipment. The work is part of an ongoing study at JPL for the National Communications System (NCS) on the use of mobile satellites for emergency communications. The purpose of the overall task is to identify and enable the technologies which will allow the NCS to use mobile satellite services for its National Security Emergency Preparedness (NSEP) communications needs. Various other government agencies will also contribute to a mobile satellite user base, and for some of these, secure communications will be an essential feature. Author

N92-24191*# Forest Service, Boise, ID.
USDA FOREST SERVICE MOBILE SATELLITE COMMUNICATIONS APPLICATIONS
John R. Warren *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 729-732 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The airborne IR signal processing system being developed will require the use of mobile satellite communications to achieve its full capability and improvement in delivery timeliness of processed IR data to the Fire Staff. There are numerous other beneficial uses, both during wildland fire management operations or in daily routine tasks, which will also benefit from the availability of reliable communications from remote areas. Author

N92-24192*# Public Service Satellite Consortium, Washington, DC.
MOBILE SATELLITE SERVICES FOR PUBLIC SAFETY, DISASTER MITIGATION AND DISASTER MEDICINE
Jerry Freibaum *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 733-737 (For primary document see N92-24071 15-32)
Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Between 1967 and 1987 nearly three million lives were lost and property damage of $25 to $100 billion resulted form natural disasters that adversely affected more than 829 million people. The social and economic impacts have been staggering and are expected to grow more serious as a result of changing demographic factors. The role that the Mobile Satellite Service can play in the International Decade is discussed. MSS was not available for disaster relief operations during the recent Loma Prieta/San Francisco earthquake. However, the results of a review of the performance of seven other communication services with respect to public sector operations during and shortly after the earthquake are described. The services surveyed were: public and private telephone, mobile radio telephone, noncellular mobile radio, broadcast media, CB radio, ham radio, and government and nongovernment satellite systems. The application of MSS to disaster medicine, particularly with respect to the Armenian earthquake is also discussed. Author

N92-24193*# British Telecom, London (England). Mobile Communications.

EUROPEAN USER TRIAL OF PAGING BY SATELLITE

R. E. Fudge and C. J. Fenton *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p 738-742 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

British Telecom conceived the idea of adapting their existing paging service, together with the use of existing terrestrial pagers, to yield a one way data (i.e., paging) satellite service to mobiles. The user trial of paging by satellites was successful. It demonstrated that services could be provided over a wide geographical area to low priced terminals. Many lessons were learned in unexpected areas. These include the need for extensive liaison with all users involved, especially the drivers, to ensure they understood the potential benefits. There was a significant desire for a return acknowledgement channel or even a return data channel. Above all there is a need to ensure that the equipment can be taken across European borders and legitimately used in all European countries. The next step in a marketing assessment would be to consider the impact of two way data messaging such as INMARSAT-C. Author

N92-24194*# Canadian Astronautics Ltd., Ottawa (Ontario).

AN AIRCRAFT EARTH STATION FOR GENERAL AVIATION

R. Matyas, J. Boughton, R. Lyons, S. Spenler, and J. Rigley (Communications Research Centre, Ottawa, Ontario) *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p A3-A8 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

While the focus has been international commercial air traffic, an opportunity exists to provide satellite communications to smaller aircraft. For these users equipment cost and weight critically impact the decision to install satellite communications equipment. Less apparent to the operator is the need for a system infrastructure that will be supported both regionally and internationally and that is compatible with the ground segment being installed for commercial aeronautical satellite communications. A system concept is described as well as a low cost terminal that are intended to satisfy the small aircraft market. Author

N92-24195*# Hughes Network Systems, Inc., Germantown, MD.

FREQUENCY STABILIZATION FOR MOBILE SATELLITE TERMINALS VIA LORAN

Gregory J. Ernst, Steven M. Kee, and Robert C. Marquart *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p A9-A14 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

Digital satellite communication systems require careful management of frequency stability. Historically, frequency stability has been accomplished by continuously powered, high cost, high performance reference oscillators. Today's low cost mobile satellite communication equipment must operate under wide ranging environmental conditions, stabilize quickly after application of power, and provide adequate performance margin to overcome RF link impairments unique to the land mobile environment. Methods for frequency stabilization in land mobile applications must meet these objectives without incurring excessive performance degradation. A frequency stabilization scheme utilizing the LORAN (Long Range Navigation) system is presented. Author

N92-24196*# Telesat Mobile, Inc., Ottawa (Ontario).

SATELLITE MOBILE DATA SERVICE FOR CANADA

Glenn R. Egan and David J. Sward *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p A15-A19 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

A commercial mobile satellite system which is to be constructed and operated in Canada is examined. This is done in two phases. First, mobile data services was introduced. Hub equipment and 3000 mobile data terminals were supplied. Over the satellite tests were performed. The mobile data service provides full two way digital messaging automatic vehicle location and fleet management services. The second phase is to construct, launch and make operational the MSAT satellite and associated network control facilities. The implementation is examined of the mobile data service in Canada, including the technical description. Marketing and applications are also examined. Author

N92-24197*# Communications Research Centre, Ottawa (Ontario).

OSI-COMPATIBLE PROTOCOLS FOR MOBILE-SATELLITE COMMUNICATIONS: THE AMSS EXPERIENCE

Michael Moher *In* JPL, California Inst. of Tech., Proceedings of the 2nd International Mobile Satellite Conference (IMSC 1990) 1990 p A20-A25 (For primary document see N92-24071 15-32)

Avail: NTIS HC/MF A99; 2 functional color pages CSCL 17B

The protocol structure of the international aeronautical mobile satellite service (AMSS) is reviewed with emphasis on those aspects of protocol performance, validation, and conformance which are peculiar to mobile services. This is in part an analysis of what can be learned from the AMSS experience with protocols which is relevant to the design of other mobile satellite data networks, e.g., land mobile. Author

N92-24249# RAND Corp., Santa Monica, CA.

TELECOMMUNICATIONS AND INFORMATION TECHNOLOGY STANDARD-SETTING IN JAPAN: A PRELIMINARY SURVEY

Stanley M. Besen 1991 27 p Sponsored in part by Boeing Commercial Airplane Group, Citicorp; The Ford Foundation; Hitachi; IBM-Japan; C. Itoh; Kawasaki Heavy Industries; Kobe Steel; John and Mary Markle Foundation; Minebea; Motorola; Nomura Research Inst.; Toshiba, UA; Xerox

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This note describes and analyzes telecommunications and information technology standard setting in Japan, compares the organization and structure of a private Japanese voluntary standard organization with those of similar European and American organizations, and examines the prospects for cooperating among these groups. Author

N92-24301*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

THE TELECOMMUNICATIONS AND DATA ACQUISITION REPORT Progress Report, Oct. - Dec. 1991

Edward C. Posner, ed. 15 Feb. 1992 325 p Original contains color illustrations

(NASA-CR-190155; JPL-TDA-PR-42-108; NAS 1.26:190155)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 17B

Archival reports on developments in programs managed by the Jet Propulsion Laboratory's (JPL's) Office of Telecommunications and Data Acquisition (TDA) are published in

the TDA Progress Report. In the search for extraterrestrial intelligence (SETI), the TDA Progress Report reports on implementation and operations for searching the microwave spectrum. In solar system radar, it reports on the uses of the Goldstone Solar System Radar for scientific exploration of the planets, their rings and satellites, asteroids, and comets. In radio astronomy, the areas of support include spectroscopy, very long baseline interferometry, and astrometry. These three programs are performed for NASA's Office of Space Science and Applications (OSSA), with the Office of Space Operations funding DSN operational support. For individual titles, see N92-24302 through N92-24323.

N92-24302*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.

A DEMONSTRATION OF CENTIMETER-LEVEL MONITORING OF POLAR MOTION WITH THE GLOBAL POSITIONING SYSTEM **c04**

U. J. Lindqwister, A. P. Freedman, and G. Blewitt *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 1-9 (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 17G

Daily estimates of the Earth's pole position were obtained with the Global Positioning System (GPS) by using measurements obtained during the GPS IERS (International Earth Rotation Service) and Geodynamics (GIG'91) experiment from 22 Jan. to 13 Feb. 1991. Data from a globally distributed network consisting of 21 Rogue GPS receivers were chosen for the analysis. A comparison of the GPS polar motion series with nine 24-hour very long baseline interferometry (VLBI) estimates yielded agreement in the day-to-day pole position of about 1.5 cm for both X and Y polar motion. A similar comparison of GPS and satellite laser ranging (SLR) data showed agreement to about 1.0 cm. These preliminary results indicate that polar motion can be determined by GPS independent of, and at a level comparable to, that which is obtained from either VLBI or SLR. Furthermore, GPS can provide these data with a daily frequency that neither alternative technique can readily achieve. Thus, GPS promises to be a powerful tool for determining high-frequency platform parameter variation, essential for the ultraprecise spacecraft-tracking requirements of the coming years. Author

N92-24303*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research.

A HIGH-PERFORMANCE Hg(+) TRAPPED ION FREQUENCY STANDARD

J. D. Prestage, R. L. Tjoelker, G. J. Dick, and L. Maleki *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 10-18 (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 20N

A high-performance frequency standard based on (199)Hg(+) ions confined in a hybrid radio frequency (RF)/dc linear ion trap is demonstrated. This trap permits storage of large numbers of ions with reduced susceptibility to the second-order Doppler effect caused by the RF confining fields. A 160-mHz-wide atomic resonance line for the 40.5-GHz clock transition is used to steer the output of a 5-mHz crystal oscillator to obtain a stability of 2 x 10(exp -15) for 24,000-second averaging times. Measurements with a 37-mHz line width for the Hg(+) clock transition demonstrate that the inherent stability for this frequency standard is better than 1 x 10(exp -15) at 10,000-second averaging times. Author

N92-24304*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.

CRITERIA FOR ULTRASTABLE OPERATION OF THE TRAPPED ION FREQUENCY STANDARD

R. L. Tjoelker, J. D. Prestage, and L. Maleki *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 19-30 (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 20N

The leading systematic perturbations to the Jet Propulsion Laboratory's (JPL's) mercury trapped ion frequency standard are characterized under present operating conditions. Sensitivity of the standard to environmental variations is measured, and the required regulation of key components to obtain a stability of 10(exp -16) is identified. Author

N92-24305*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Navigation Systems Section.

ORBIT-DETERMINATION PERFORMANCE OF DOPPLER DATA FOR INTERPLANETARY CRUISE TRAJECTORIES. PART 1: ERROR ANALYSIS METHODOLOGY **c13**

J. S. Ulvestad and S. W. Thurman *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 31-48 (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 22A

An error covariance analysis methodology is used to investigate different weighting schemes for two-way (coherent) Doppler data in the presence of transmission-media and observing-platform calibration errors. The analysis focuses on orbit-determination performance in the interplanetary cruise phase of deep-space missions. Analytical models for the Doppler observable and for transmission-media and observing-platform calibration errors are presented, drawn primarily from previous work. Previously published analytical models were improved upon by the following: (1) considering the effects of errors in the calibration of radio signal propagation through the troposphere and ionosphere as well as station-location errors; (2) modelling the spacecraft state transition matrix using a more accurate piecewise-linear approximation to represent the evolution of the spacecraft trajectory; and (3) incorporating Doppler data weighting functions that are functions of elevation angle, which reduce the sensitivity of the estimated spacecraft trajectory to troposphere and ionosphere calibration errors. The analysis is motivated by the need to develop suitable weighting functions for two-way Doppler data acquired at 8.4 GHz (X-band) and 32 GHz (Ka-band). This weighting is likely to be different from that in the weighting functions currently in use; the current functions were constructed originally for use with 2.3 GHz (S-band) Doppler data, which are affected much more strongly by the ionosphere than are the higher frequency data. Author

N92-24306*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Navigation Systems Section.

ORBIT-DETERMINATION PERFORMANCE OF DOPPLER DATA FOR INTERPLANETARY CRUISE TRAJECTORIES. PART 2: 8.4-GHz PERFORMANCE AND DATA-WEIGHTING STRATEGIES **c13**

J. S. Ulvestad *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 49-65 (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 22A

A consider error covariance analysis was performed in order to investigate the orbit-determination performance attainable using two-way (coherent) 8.4-GHz (X-band) Doppler data for two segments of the planned Mars Observer trajectory. The analysis includes the effects of the current level of calibration errors in tropospheric delay, ionospheric delay, and station locations, with particular emphasis placed on assessing the performance of several candidate elevation-dependent data-weighting functions. One weighting function was found that yields good performance for a variety of tracking geometries. This weighting function is simple and robust; it reduces the danger of error that might exist if an analyst had to select one of several different weighting functions that are highly sensitive to the exact choice of parameters and to the tracking geometry. Orbit-determination accuracy improvements that may be obtained through the use of calibration data derived from Global Positioning System (GPS) satellites also were investigated, and can be as much as a factor of three in some components of the spacecraft state vector. Assuming that both station-location errors and troposphere calibration errors are reduced simultaneously, the recommended data-weighting function need not be changed when GPS calibrations are incorporated in the orbit-determination process. Author

N92-24307*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Navigation Systems Section.
THE X-WINDOWS INTERACTIVE NAVIGATION DATA EDITOR **c17**
G. C. Rinker *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 66-78 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 17G

A new computer program called the X-Windows Interactive Data Editor (XIDE) was developed and demonstrated as a prototype application for editing radio metric data in the orbit-determination process. The program runs on a variety of workstations and employs pull-down menus and graphical displays, which allow users to easily inspect and edit radio metric data in the orbit data files received from the Deep Space Network (DSN). The XIDE program is based on the Open Software Foundation OSF/Motif Graphical User Interface (GUI) and has proven to be an efficient tool for editing radio metric data in the navigation operations environment. It was adopted by the Magellan Navigation Team as their primary data-editing tool. Because the software was designed from the beginning to be portable, the prototype was successfully moved to new workstation environments. It was also itegrated into the design of the next-generation software tool for DSN multimission navigation interactive launch support. Author

N92-24308*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
ALIGNMENT OF THE ATMOSPHERIC VISIBILITY MONITORING TELESCOPE **c89**
K. Cowles and D. Erickson *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 79-83 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 03A

Alignment of the first Atmospheric Visibility Monitoring Telescope has revealed errors in mount design, mount manufacture, software, and electronics. This article discusses error sources and solutions, and re-alignment results. Alignment requirements for operation are also presented. The telescope now operates with the desired accuracy and repeatability. Author

N92-24309*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NONLINEAR, NONBINARY CYCLIC GROUP CODES **c64**
G. Solomon *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 84-95 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 12A

New cyclic group codes of length 2(exp m) - 1 over (m - j)-bit symbols are introduced. These codes can be systematically encoded and decoded algebraically. The code rates are very close to Reed-Solomon (RS) codes and are much better than Bose-Chaudhuri-Hocquenghem (BCH) codes (a former alternative). The binary (m - j)-tuples are identified with a subgroup of the binary m-tuples which represents the field GF(2 exp m). Encoding is systematic and involves a two-stage procedure consisting of the usual linear feedback register (using the division or check polynomial) and a small table lookup. For low rates, a second shift-register encoding operation may be invoked. Decoding uses the RS error-correcting procedures for the m-tuple codes for m = 4, 5, and 6. Author

N92-24310*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
REAL-TIME ANTENNA FAULT DIAGNOSIS EXPERIMENTS AT DSS 13
J. Mellstrom, C. Pierson, and P. Smyth *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 96-108 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 20N

Experimental results obtained when a previously described fault diagnosis system was run online in real time at the 34-m beam waveguide antenna at Deep Space Station (DSS) 13 are described. Experimental conditions and the quality of results are described. A neural network model and a maximum-likelihood Gaussian classifier are compared with and without a Markov component to model temporal context. At the rate of a state update every 6.4 seconds, over a period of roughly 1 hour, the neural-Markov system had zero errors (incorrect state estimates) while monitoring both faulty and normal operations. The overall results indicate that the neural-Markov combination is the most accurate model and has significant practical potential. Author

N92-24311*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
POINTING-ERROR SIMULATIONS OF THE DSS-13 ANTENNA DUE TO WIND DISTURBANCES
W. Gawronski, B. Bienkiewicz (Colorado Univ., Boulder.), and R. E. Hill *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 109-134 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 20N

Accurate spacecraft tracking by the NASA Deep Space Network (DSN) antennas must be assured during changing weather conditions. Wind disturbances are the main source of tracking errors. The development of a wind-force model and simulations of wind-induced pointing errors of DSN antennas are presented. The antenna model includes the antenna structure, the elevation and azimuth servos, and the tracking controller. Simulation results show that pointing errors due to wind gusts are of the same order as errors due to static wind pressure and that these errors (similar to those of static wind pressure) satisfy the velocity quadratic law. The presented methodology is used for wind-disturbance estimation and for the design of an antenna controller with wind-disturbance rejection properties. Author

N92-24312*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
DSS-13 BEAM-WAVEGUIDE ANTENNA PERFORMANCE IN THE BYPASS MODE
S. R. Stewart (Planning Research Corp., Pasadena, CA.) *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 135-153 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 20N

A new 34-meter beam-waveguide (BWG) antenna that contains two microwave paths, a centerline feed system, and a bypass feed system, was built at the Deep Space Station 13 (DDS 13) at Goldstone, California. Previous articles have described the test results from the evaluation of the centerline BWG feed system in the receive mode as well as the test package hardware used to perform these tests. The test results from the evaluation of the bypass BWG feed system on the DSS-13 antenna in the receive mode, including the operating noise-temperature and the antenna-area-efficiency measurements, are presented. Author

N92-24313*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
THE ELECTRICAL CONDUCTIVITIES OF THE DSS-13 BEAM-WAVEGUIDE ANTENNA SHROUD MATERIAL AND OTHER ANTENNA REFLECTOR SURFACE MATERIALS
T. Y. Otoshi, M. M. Franco, and H. F. Reilly, Jr. *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 154-164 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 20N

A significant amount of noise temperature can potentially be generated by currently unknown dissipative losses in the beam waveguide (BWG) shroud. The amount of noise temperature contribution from this source is currently being studied. In conjunction with this study, electrical conductivity measurements were made on samples of the DSS-13 BWG shroud material at 8.420 GHz. The effective conductivities of unpainted and painted samples of the BWG shroud were measured to be 0.01 x 10(exp 7) and 0.0036 x 10(exp 7) mhos/m, respectively. This value may be compared with 5.66 x 10(exp 7) mhos/m for high conductivity copper. Author

N92-24314*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Information Systems Div.

SOFTWARE-ENGINEERING PROCESS SIMULATION (SEPS) MODEL **c61**

C. Y. Lin, T. Abdel-Hamid (Naval Postgraduate School, Monterey, CA.), and J. S. Sherif *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 165-185 Prepared in cooperation with California State Univ., Fullerton (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 09B

The Software Engineering Process Simulation (SEPS) model is described which was developed at JPL. SEPS is a dynamic simulation model of the software project development process. It uses the feedback principles of system dynamics to simulate the dynamic interactions among various software life cycle development activities and management decision making processes. The model is designed to be a planning tool to examine tradeoffs of cost, schedule, and functionality, and to test the implications of different managerial policies on a project's outcome. Furthermore, SEPS will enable software managers to gain a better understanding of the dynamics of software project development and perform postmodern assessments. Author

N92-24315*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.

NODE SYNCHRONIZATION SCHEMES FOR THE BIG VITERBI DECODER

K.-M. Cheung, L. Swanson, and S. Arnold *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 186-200 (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 20N

The Big Viterbi Decoder (BVD), currently under development for the DSN, includes three separate algorithms to acquire and maintain node and frame synchronization. The first measures the number of decoded bits between two consecutive renormalization operations (renorm rate), the second detects the presence of the frame marker in the decoded bit stream (bit correlation), while the third searches for an encoded version of the frame marker in the encoded input stream (symbol correlation). A detailed account of the operation is given, as well as performance comparison, of the three methods. Author

N92-24316*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Radio Frequency and Microwave Subsystems Section.

THE 250-kW CW KLYSTRON AMPLIFIER FOR PLANETARY RADAR

R. Cormier and A. Mizuhara (Varian Associates, Palo Alto, CA.) *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 201-213 (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 20I

The design, construction, and performance testing is described of two Varian klystrons, model VKX-7864A, which replaced the aging and less efficient VA-949J klystrons in the X band planetary radar transmitter on the Goldstone, CA, 70 meter antenna. The project was carried out jointly by the JPL and Varian Assoc. Output power was increased from 200 to 250 kW continuous wave per klystron, and full dc beam power is dissipated in the collector (it was not possible to operate the VA-949J klystrons without RF drive because of limited collector dissipation capability). Replacements were made with a minimum of transmitter modifications. The planetary radar transmitter is now operating successfully with these two klystrons. Author

N92-24317*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.

AN ASSEMBLY TO PROVIDE A TIME REFERENCE FOR THE JPL NETWORK OPERATIONS CONTROL CENTER, REAL-TIME **c35**

P. A. Clements, J. G. Lopez, and M. J. Kelley (Telos Corp., Pasadena, CA.) *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 214-221 (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 14B

A device is described which provides the value of date coordinated universal time (date UTC) to the JPL Network Operations Control Center, Real Time (NOCC-RT) facility. The NOCC-RT is the real time portion of the NOCC upgrade task. The time scale is generated in the NOCC-RT clock processor; however, there is a continuous reference to UTC, as realized by the National Institute of Standards and Technology and transmitted by Earth orbiting satellites. An important functional design requirement is the 99.9 pct. availability. Author

N92-24318*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.

DYNAMIC MODELING OF THE SERVOVALVES INCORPORATED IN THE SERVO HYDRAULIC SYSTEM OF THE 70-METER DSN ANTENNAS **c37**

R. D. Bartos *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 222-234 (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 13I

As the pointing accuracy and service life requirements of the DSN 70 meter antenna increase, it is necessary to gain a more complete understanding of the servo hydraulic system in order to improve system designs to meet the new requirements. A mathematical model is developed for the servovalve incorporated into the hydraulic system of the 70 meter antenna and uses experimental data to verify the validity of the model and to identify the model parameters. Author

N92-24319*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.

A MICROWAVE HOLOGRAPHY METHODOLOGY FOR DIAGNOSTICS AND PERFORMANCE IMPROVEMENT FOR LARGE REFLECTOR ANTENNAS **c35**

D. J. Rochblatt *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 235-252 Original contains color illustrations (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 14E

This microwave holography technique utilizes the Fourier transform relation between the complex far field radiation pattern of an antenna and the complex aperture field distribution. Resulting aperture phase and amplitude distribution data can be used to precisely characterize various crucial performance parameters, including panel alignment, panel shaping, subreflector position, antenna aperture illumination, directivity at various frequencies, and gravity deformation effects. The methodology of data processing presented here was successfully applied to the Deep Space Network (DSN) 34-m beam waveguide antennas. The antenna performance was improved at all operating frequencies by reducing the main reflector mechanical surface rms error to 0.43 mm. At Ka-band (32 GHz), the estimated improvement is 4.1 dB, resulting in an aperture efficiency of 52 percent. The performance improvement was verified by efficiency measurements and additional holographic measurements. Author

N92-24320*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.

PERFORMANCE IMPROVEMENT OF DSS-13 34-METER BEAM-WAVEGUIDE ANTENNA USING THE JPL MICROWAVE HOLOGRAPHY METHODOLOGY **c35**

D. J. Rochblatt and B. L. Seidel *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 253-270 Original contains color illustrations (For primary document see N92-24301 15-32)

Avail: NTIS HC/MF A14; 13 functional color pages CSCL 14E

Described here is the application of the microwave holography technique to Deep Space Station (DSS) 13. The project goal of obtaining a rigging angle surface rms error of 0.43 mm or better was met. The Jet Propulsion Laboratory-developed holography algorithms enabled a reduction of the surface error of the DSS-13

antenna from the optically set 0.83 mm axial rms error down to 0.40 mm rms, providing an additional 4.1 dB of performance at 32 GHz. Author

N92-24321*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. TDA Technology Development.
DSN G/T(SUB op) AND TELECOMMUNICATIONS SYSTEM PERFORMANCE
C. Stelzried, R. Clauss, W. Rafferty, and S. Petty *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 271-278 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 17B

Provided here is an intersystem comparison of present and evolving Deep Space Network (DSN) microwave receiving systems. Comparisons of the receiving systems are based on the widely used G/T sub op figure of merit, which is defined as antenna gain divided by operating system noise temperature. In 10 years, it is expected that the DSN 32 GHz microwave receiving system will improve the G/T sub op performance over the current 8.4 GHz system by 8.3 dB. To compare future telecommunications system end-to-end performance, both the receiving systems' G/T sub op and spacecraft transmit parameters are used. Improving the 32 GHz spacecraft transmitter system is shown to increase the end-to-end telecommunications system performance an additional 3.2 dB, for a net improvement of 11.5 dB. These values are without a planet in the field of view (FOV). A Saturn mission is used for an example calculation to indicate the degradation in performance with a planet in the field of view. Author

N92-24322*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Tracking Systems and Applications Section.
POSITION DETERMINATION OF A LANDER AND ROVER AT MARS WITH EARTH-BASED DIFFERENTIAL TRACKING c04
R. D. Kahn, W. M. Folkner, C. D. Edwards, and A. Vijayaraghavan *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 279-293 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 17G

The presence of two or more landed or orbiting spacecraft at a planet provides the opportunity to perform extremely accurate Earth-based navigation by simultaneously acquiring Doppler data and either Same-Beam Interferometry (SBI) or ranging data. Covariance analyses were performed to investigate the accuracy with which lander and rover positions on the surface of Mars can be determined. Simultaneous acquisition of Doppler and ranging data from a lander and rover over two or more days enables determination of all components of their relative position to under 20 m. Acquiring one hour of Doppler and SBI enables three dimensional lander-rover relative position determination to better than 5 m. Twelve hours of Doppler and either SBI or ranging from a lander and a low circular or half synchronous circular Mars orbiter makes possible lander absolute position determination to tens of meters. Author

N92-24323*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
USING SINGLE BUFFERS AND DATA REORGANIZATION TO IMPLEMENT A MULTI-MEGASAMPLE FAST FOURIER TRANSFORM c55
R. D. Brown *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 294-306 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 06L

Data ordering in large fast Fourier transforms (FFT's) is both conceptually and implementationally difficult. Discribed here is a method of visualizing data orderings as vectors of address bits, which enables the engineer to use more efficient data orderings and reduce double-buffer memory designs. Also detailed are the difficulties and algorithmic solutions involved in FFT lengths up to 4 megasamples (Msamples) and sample rates up to 80 MHz. Author

N92-24545*# Arizona State Univ., Tempe. Dept. of Electrical Engineering.
ANTENNA PATTERN CONTROL USING IMPEDANCE SURFACES Semiannual Progress Report, 16 Sep. 1991 - 15 Mar. 1992
Constantine A. Balanis and Kefeng Liu 15 Mar. 1992 33 p (Grant NAG1-1183)
(NASA-CR-190218; NAS 1.26:190218) Avail: NTIS HC/MF A03 CSCL 20N

The modification of a moment method code is described. Analyses of horn antennas were conducted extensively. Excellent agreements with measured results were observed for pyramidal horn antennas with perfectly conducting surfaces. The predicted results are so accurate that even the finest ripple structures in the far-field radiation patterns are computed correctly. Preliminary results for the radiation patterns of pyramidal horns with impedance surfaces were also obtained. Discussions of using the code in accurate modeling of practical pyramidal horn antennas are also included. After the code for the analysis of the horn antennas with impedance materials is finalized, the synthesis problem will be examined in the coming research period. Author

N92-24562 Physics and Electronics Lab. TNO, The Hague (Netherlands).
CALIBRATED RADIOMETER FOR BACKGROUND SCANNING: CARABAS Final Report
R. vanderTouw Nov. 1991 88 p
(FEL-91-B201; TD91-3893; ETN-92-91223) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, Netherlands

Thermal characteristics of targets and backgrounds determine IR detectability of the targets. Therefore not only knowledge of the thermal behavior of targets is needed, but also of background elements like trees and grass. Long term measurements are necessary to study time variations of apparent temperatures, covering all weather conditions. For this reason, a dual waveband scanner is developed for autonomous radiation measurements in the spectral regions 3 to 5 and 8 to 12 micrometers. System design and performance are described. ESA

N92-24565 Physics and Electronics Lab. TNO, The Hague (Netherlands).
ESTIMATION OF THE PARAMETERS USED IN THE AZIMUTH COMPRESSION Final Report
F. P. P. deVries Nov. 1991 41 p Sponsored by Netherlands Agency for Aerospace Programs
(FEL-91-B331; TD91-3978; ETN-92-91226) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, Netherlands

In azimuth processing of SAR (Synthetic Aperture Radar) data, the slant range histories of the targets are required. After range compression, the maxima of the responses of point targets are in the so called range migration locus. For spaceborne SAR, the locus traverses a number of range bins. This locus determines where to get the samples needed for the azimuth compression and the phase function which must be used. For satellite SAR the locus can be described by two parameters, the Doppler centroid and the frequency rate. These parameters can be estimated by using accurate spacecraft ancillary data and by utilizing the received radar data alone. The effects of errors in the parameters used by the processor are described and algorithms to estimate the parameters are discussed. Examples of results from processing Seasat data are shown. ESA

N92-24574# Lawrence Livermore National Lab., CA.
PHASE INFORMATION IN RADAR AND OPTICAL IMAGING
J. P. Fitch Dec. 1991 11 p Presented at the Signal Theory and Image Processing, Cetraro, Italy, 26-31 May 1991
(Contract W-7405-eng-48)
(DE92-008562; UCRL-JC-108930; CONF-9105308-1) Avail: NTIS HC/MF A03

The importance of phase as an information carrier is examined for two applications. The first application is atmospheric

compensation of optical signals collected with ground-based telescopes and the second is synthetic aperture radar image formation and data analysis. The basic theory and algorithms for both applications are presented. DOE

N92-24795*# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
FDTD MODELING OF THIN IMPEDANCE SHEETS
Raymond Luebbers and Karl Kunz 1991 17 p
(Grant NAG1-1221)
(NASA-CR-190105; NAS 1.26:190105) Avail: NTIS HC/MF A03 CSCL 20N

Thin sheets of resistive or dielectric material are commonly encountered in radar cross section calculations. Analysis of such sheets is simplified by using sheet impedances. It is shown that sheet impedances can be modeled easily and accurately using Finite Difference Time Domain (FDTD) methods. These sheets are characterized by a discontinuity in the tangential magnetic field on either side of the sheet but no discontinuity in tangential electric field. This continuity, or single valued behavior of the electric field, allows the sheet current to be expressed in terms of an impedance multiplying this electric field. Author

N92-24891*# Brown Univ., Providence, RI. Div. of Engineering.
LABORATORY FOR ENGINEERING MAN/MACHINE SYSTEMS (LEMS): SYSTEM IDENTIFICATION, MODEL REDUCTION AND DECONVOLUTION FILTERING USING FOURIER BASED MODULATING SIGNALS AND HIGH ORDER STATISTICS
Semiannual Report No. 5
JianQiang Pan Mar. 1992 169 p
(Grants NAG1-1065; NSF ECS-87-13771)
(NASA-CR-190265; NAS 1.26:190265; LEMS-TR-103) Avail: NTIS HC/MF A08 CSCL 20N

Several important problems in the fields of signal processing and model identification, such as system structure identification, frequency response determination, high order model reduction, high resolution frequency analysis, deconvolution filtering, and etc. Each of these topics involves a wide range of applications and has received considerable attention. Using the Fourier based sinusoidal modulating signals, it is shown that a discrete autoregressive model can be constructed for the least squares identification of continuous systems. Some identification algorithms are presented for both SISO and MIMO systems frequency response determination using only transient data. Also, several new schemes for model reduction were developed. Based upon the complex sinusoidal modulating signals, a parametric least squares algorithm for high resolution frequency estimation is proposed. Numerical examples show that the proposed algorithm gives better performance than the usual. Also, the problem was studied of deconvolution and parameter identification of a general noncausal nonminimum phase ARMA system driven by non-Gaussian stationary random processes. Algorithms are introduced for inverse cumulant estimation, both in the frequency domain via the FFT algorithms and in the domain via the least squares algorithm. Author

N92-24961# Helsinki Univ. of Technology, Espoo (Finland). Communications Lab.
DESIGN OF FIBER-OPTIC DIGITAL COMMUNICATION SYSTEMS. INTRODUCTORY COURSE FOR STUDENTS IN COMMUNICATIONS ENGINEERING
T. A. Eftimov 26 Apr. 1991 99 p
(PB92-141480; Rept-04) Avail: NTIS HC/MF A05 CSCL 17B

The handbook intends to provide the basic concepts about the components necessary to design a fiber-optic link and the communication system itself. A student or a beginner in optical fiber communications is introduced to the basic concepts, characteristics, and parameters of the components from a practical point of view. Therefore, the text is heavily illustrated. The mathematics involved is reduced to the absolute minimum and all of the calculations can be performed with a simple pocket calculator. Unlike most university textbooks, the practical parameters of devices needed as ordering information are specially outlined. Special attention was paid to simplified design examples of the most typical up-to-date digital communication systems. These together with the problems should help the student acquire the minimum but solid knowledge in this so rapidly developing communications world. GRA

N92-25048# Lawrence Livermore National Lab., CA.
A COMPARISON OF SOLUTIONS FOR WIRES OVER GROUND
G. J. Burke Jan. 1992 8 p Presented at the Annual Review of Progress in Applied Computational Electromagnetics, Monterey, CA, 17-19 Mar. 1992
(Contract W-7405-eng-48)
(DE92-008623; UCRL-JC-108585; CONF-920396-1) Avail: NTIS HC/MF A02

Validation of the Numerical Electromagnetics Code-2 (NEC-2) and three antenna modeling codes for wires over ground has been a problem of continuing concern due to the lack of independent numerical or analytical solutions and the difficulty of obtaining measured data of high accuracy and for known ground parameters. In this paper, the complex propagation constants for wires of varying height above ground are obtained from the NEC solution by analyzing the computed current distribution, and the values are compared with analytic and approximate solutions for infinite wires over ground. The results support the accuracy of NEC for horizontal wires over ground and also demonstrate the relative accuracy of approximate transmission-line formulas as a function of the index of refraction of the ground. DOE

N92-25104# Technical Univ. of Lisbon (Portugal). Inst. Superior Tecnico.
WAVE PROPAGATION IN CYLINDRICAL E-RADIALLY INHOMOGENEOUS WAVEGUIDE Ph.D. Thesis
I. M. S. P. Neves 1990 253 p In PORTUGUESE; ENGLISH summary
(PB92-138833) Avail: NTIS HC/MF A12 CSCL 20N

A method is presented for studying the propagation characteristics of an electromagnetic wave in a cylindrical dielectric structure, with an arbitrary number of inhomogeneous coaxial layers. The dispersive equation for the structure is established. Its elements are calculated as a series expansion about a number of points of the radial coordinate. These methods are applied to specific dielectric waveguide structures, considering both small and high values of the dielectric step. Families of dispersion curves are obtained, allowing some interesting interpretations of the characteristics of type A and type V waveguide structures. A rigorous classification of hybrid modes is proposed. Author

N92-25137*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RADAR MULTIPATH STUDY FOR RAIN-ON-RADOME EXPERIMENTS AT THE AIRCRAFT LANDING DYNAMICS FACILITY
Anne I. MacKenzie and Leo D. Staton May 1990 42 p
(NASA-TM-101657; NAS 1.15:101657) Avail: NTIS HC/MF A03 CSCL 20N

An analytical study to determine the feasibility of a rain-on-radome experiment at the Aircraft Landing Dynamics Facility (ALDF) at the Langley Research Center is described. The experiment would measure the effects of heavy rain on the transmission of X-band weather radar signals, looking in particular for sources of anomalous attenuation. Feasibility is determined with regard to multipath signals arising from the major structural components of the ALDF. A computer program simulates the transmit and receive antennas, direct-path and multipath signals, and expected attenuation by rain. In the simulation, antenna height, signal polarization, and rainfall rate are variable parameters. The study shows that the rain-on-radome experiment is feasible with regard to multipath signals. The total received signal, taking into account multipath effects, could be measured by commercially available equipment. The study also shows that horizontally polarized signals would produce better experimental results than vertically polarized signals. Author

N92-24388# Technische Hochschule, Aachen (Germany, F.R.). Lehrstuhl Informatik.
DFG RESEARCH PROJECT SATELLITE NETWORKS AND ISDN [DFG-FORSCHUNGSVORHABEN SATELLITENNETZE UND ISDN]
O. Spaniol, U. Quernheim, M. Aghadavoodi Jolfaei, and D. Kreuer *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 95-98 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24731# Technische Univ., Delft (Netherlands). Faculty of Aerospace Engineering.
SOME RESULTS OF THE ERS-1 RADAR ALTIMETER CALIBRATION
Karel F. Wakker, R. Scharroo, and B. A. C. Ambrosius *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 73-79 (For primary document see N92-24719 15-12)
Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24732# Munich FAF Univ., Neubiberg (Germany, F.R.). Inst. of Astronomical and Physical Geodesy.
CALIBRATING THE ERS-1 RADAR ALTIMETER BY USING GPS IN BUOYS
Guenter W. Hein, Herbert Landau, and Helmut Blomenhofer *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 81-90 Sponsored by Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H. (For primary document see N92-24719 15-12)
Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24921# Fern Univ., Hagen (Germany, F.R.). Fachgebiet Kommunikationssysteme.
RELIABILITY OF NETWORKS USING STATIC ROUTING
Werner Poguntke *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 95-99 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

N92-25008 Los Alamos National Lab., NM.
SWEPT-FREQUENCY NEAR MILLIMETER WAVE CHARACTERISATION OF SAMPLES IN AN INTERNATIONAL SAMPLE EXCHANGE
H. M. Frost, III and R. S. Vigil *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 2 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

N92-25014 Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).
INTERNATIONAL COMPARISON MEASUREMENTS AT NEAR MILLIMETRE WAVELENGTHS
In National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 5 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N92-24209# Brookhaven National Lab., Upton, NY.
DESIGN OF THE AGS BOOSTER BEAM POSITION MONITOR ELECTRONICS
D. J. Ciardullo, G. A. Smith, and E. R. Beadle 1991 4 p Presented at the 1991 Institute of Electrical and Electronics Engineers (IEEE) Particle Accelerator Conference (PAC), San Francisco, CA, 6-11 May 1991
(Contract DE-AC02-76CH-00016)
(DE92-007577; BNL-45419; CONF-910505-434) Avail: NTIS HC/MF A01

The operational requirements of the AGS Booster Beam Position Monitor system necessitate the use of electronics with wide dynamic range and broad instantaneous bandwidth. Bunch synchronization is provided by a remote timing sequencer coupled to the local ring electronics via digital fiber-optic links. The sequencer and local ring circuitry work together to provide single turn trajectory or average orbit and intensity information, integrated over 1 to 225 bunches. Test capabilities are built in for the purpose of enhancing BPM system accuracy. This paper describes the design of the Booster Beam Position Monitor electronics, and presents performance details of the front end processing, acquisition, and timing circuitry. DOE

N92-24211# Brookhaven National Lab., Upton, NY.
EXAFS STUDIES OF BATTERY MATERIALS
J. McBreen 1991 13 p Presented at the 180th Meeting of the Electrochemical Society, Phoenix, AZ, 13-18 Oct. 1991
(Contracts DE-AC02-76CH-00016; DE-FG05-89ER-45384)
(DE92-007599; BNL-46092; CONF-911047-15) Avail: NTIS HC/MF A03

X-ray absorption spectroscopy (XAS) was used extensively at Brookhaven National Laboratory (BNL) to study materials and electrodes of several battery systems. The power and the general applicability of the technique is illustrated by studies of several battery materials such as PEO-salt complexes, PbO_2, and in situ studies of mossy zinc deposition in alkaline electrolyte. DOE

N92-24234 Materials Research Labs., Ascot Vale (Australia).
SWITCH INTERFACE FOR MONOCHROMATOR AND RADIOMETER
G. A. Clark Mar. 1992 21 p
(MRL-TN-598) Copyright Avail: Issuing Activity

This note describes a digital switch interface that has been designed and constructed. The unit enables an IBM compatible personal computer to control and collect data from an Optronics Laboratory monochromator and two radiometers but could also be used for control of other instruments with digital input and/or output. Modifications to achieve a master/slave configuration with the clocks of the analog to digital convertors in the radiometers are also described. Author

N92-24246*# National Aeronautics and Space Administration. Pasadena Office, CA.
AN IMPROVED SNS SUPERCONDUCTING JUNCTION WITH WEAK LINK BARRIER AND METHOD OF PRODUCING Patent Application
B. D. Hunt, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 19 Mar. 1992 27 p
(Contract NAS7-918)
(NASA-Case-NPO-18552-1-CU; NAS 1.71:NPO-18552-1-CU; US-Patent-Appl-SN-854124) Avail: NTIS HC/MF A03 CSCL 09A

A method of producing a high temperature superconductor Josephson element and an improved SNS weak link barrier element

is provided. A YBaCuO superconducting electrode film is deposited on a substrate at a temperature of approx. 800 C. A weak link barrier layer of a nonsuperconducting film of N-YBaCuO is deposited over the electrode at a temperature range of 520 to 540 C at a lower deposition rate. Subsequently, a superconducting counter-electrode film layer of YBaCuO is deposited over the weak link barrier layer at approx. 800 C. The weak link barrier layer has a thickness of approx. 50 A and the SNS element can be constructed to provide an edge geometry junction. NASA

N92-24267# International Centre for Theoretical Physics, Trieste (Italy).
THE ODD VOIGT EFFECT UNDER A STRONG ELECTRIC FIELD IN SEMICONDUCTORS
Nguyen Hong Shon Aug. 1991 10 p
(DE92-615482; IC-91/224) Avail: NTIS HC/MF A02

The high frequency conductivity tensor sigma(sub ik)(omega) in the linear approximation of the magnetic field H and in the quadratic approximation of external dc electric field is derived by solving the Boltzmann equation. The magneto-optical phenomena in the Voigt configuration (when a probe electro-magnetic wave propagates across a magnetic field) are investigated. It is shown that the birefringence and dichroism have a component that is odd (linear) in the magnetic fields and predominate over the even effect in the weak magnetic field. DOE

N92-24551# Argonne National Lab., IL.
KEY RESULTS OF BATTERY PERFORMANCE AND LIFE TESTS AT ARGONNE NATIONAL LABORATORY
W. H. DeLuca, K. R. Gillie, J. E. Kulaga, J. A. Smaga, A. F. Tummillo, and C. E. Webster 1991 8 p Presented at the Automotive Technology Development Contractors' Coordination Meeting, Dearborn, MI, 22-25 Oct. 1991
(Contract W-31-109-eng-38)
(DE92-009729; ANL/CP-75570; CONF-911050-7) Avail: NTIS HC/MF A02

Advanced battery technology evaluations are performed under simulated electric vehicle operating conditions at Argonne National Laboratory's & Diagnostic Laboratory (ADL). The ADL provide a common basis for both performance characterization and life evaluation with unbiased application of tests and analyses. This paper summarizes the performance characterizations and life evaluations conducted in 1991 on twelve single cells and eight 3- to 360-cell modules that encompass six battery technologies (Na/S, Li/MS, Ni/MH, Zn/Br, Ni/Fe, and Pb-Acid). These evaluations were performed for the Department of Energy, Office of Transportation Technologies, Electric and Hybrid Propulsion Division. The results measure progress in battery R & D programs, compare battery technologies, and provide basic data for modeling and continuing R & D to battery users, developers, and program managers. DOE

N92-24566# Sandia National Labs., Albuquerque, NM.
MULTICHIP MODULE ENABLERS FOR HIGH RELIABILITY APPLICATIONS
D. Chu, C. A. Reber, B. L. Draper, J. N. Sweet, and D. W. Palmer 1991 5 p Presented at the IEEE Multichip Module Conference, Santa Cruz, CA, 18-20 Mar. 1992
(Contract DE-AC04-76DP-00789)
(DE92-007659; SAND-91-2738C; CONF-920387-1) Avail: NTIS HC/MF A01

Multichip modules (MCM's) intended for decades of highly reliable operation require more than the manufacturer's assurance based on one product-specific qualification test. There are few MCM production and field track records on which to base such confidence. To gain uniform, rigorous MCM qualification for high reliability applications, Sandia has developed a set of assembly test chips which are available for manufacturers and users to evaluate, characterize, and compare the particular MCM technology in terms of materials, chemical aging, geometries, stress state, thermal management, and assembly techniques. DOE

N92-24711# Argonne National Lab., IL.
HIGH-TEMPERATURE SUPERCONDUCTOR APPLICATIONS DEVELOPMENT AT ARGONNE NATIONAL LABORATORY
J. R. Hull and R. B. Poeppel Feb. 1992 10 p Presented at the High Tc SUH Workshop on HTS Materials, Bulk Processing and Bulk Applications, Houston, TX, 27-28 Feb. 1992
(Contract W-31-109-eng-38)
(DE92-009728; ANL/CP-75331; CONF-920240-1) Avail: NTIS HC/MF A02

Developments at Argonne National Laboratory of near and intermediate term applications using high-temperature superconductors are discussed. Near-term applications of liquid-nitrogen depth sensors, current leads, and magnetic bearings are discussed in detail. DOE

N92-24892# Oak Ridge National Lab., TN.
ADVANCED TECHNIQUES IN CURRENT SIGNATURE ANALYSIS
S. F. Smith and K. N. Castleberry 1992 14 p Presented at the 46th Meeting of the Mechanical Failures Prevention Group, Virginia Beach, VA, 7-9 Apr. 1992
(Contract DE-AC05-84OR-21400)
(DE92-007680; CONF-920474-2) Avail: NTIS HC/MF A03

In general, both ac and dc motors can be characterized as weakly nonlinear systems, in which both linear and nonlinear effects occur simultaneously. Fortunately, the nonlinearities are generally well behaved and understood and can be handled via several standard mathematical techniques already well developed in the systems modeling area; examples are piecewise linear approximations and Volterra series representations. Field measurements of numerous motors and motor-driven systems confirm the rather complex nature of motor current spectra and illustrate both linear and nonlinear effects (including line harmonics and modulation components). Although previous current signature analysis (CSA) work at Oak Ridge and other sites has principally focused on the modulation mechanisms and detection methods (AM, PM, and FM), more recent studies have been conducted on linear spectral components (those appearing in the electric current at their actual frequencies and not as modulation sidebands). For example, large axial-flow compressors (approximately 3300 hp) in the US gaseous diffusion uranium enrichment plants exhibit running-speed (approximately 20 Hz) and high-frequency vibrational information (greater than 1 kHz) in their motor current spectra. Several signal-processing techniques developed to facilitate analysis of these components, including specialized filtering schemes, are presented. Finally, concepts for the designs of advanced digitally based CSA units are offered, which should serve to foster the development of much more computationally capable 'smart' CSA instrumentation in the next several years. DOE

N92-25059# Allied-Signal Aerospace Co., Kansas City, MO.
EVALUATION OF 2 SOLUTIONS FOR A 15 GHz DC BLOCKING CAPACITOR
P. E. Fry Feb. 1992 40 p
(Contract DE-AC04-76DP-00613)
(DE92-008005; KCP-613-4625) Avail: NTIS HC/MF A03

An evaluation was made of different blocking capacitors for the Advanced Microwave Technology Process Development Order at the Kansas City Division. The discrete chip capacitor exhibited large performance variations and processing problems. The interdigitated capacitor exhibited excellent performance repeatability, and its processing problems are easier to overcome, compared to the chip capacitor. DOE

N92-25061# Allied-Signal Aerospace Co., Kansas City, MO.
DEVELOPMENT OF A PULSE-ARC WELDING POWER SUPPLY
D. L. Hollar Feb. 1992 17 p
(Contract DE-AC04-76DP-00613)
(DE92-008010; KCP-613-4004) Avail: NTIS HC/MF A03

A new pulse-arc (PA) weld system similar to gas tungsten arc welding (GTAW) was designed and developed. It replaces a previous design which has been in use by Allied-Signal Inc., Kansas City Division (KCD), for about 20 years. The new design

incorporates state-of-the-art electronics and modular design. The system was proved in with the fabrication of a laboratory prototype and one made-to-drawing unit. DOE

N92-25094*# Clemson Univ., SC. Dept. of Ceramic Engineering.
SUPERCONDUCTIVITY DEVICES: COMMERCIAL USE OF SPACE Semiannual Report, Jul. 1991 - Apr. 1992
Gene Haertling, Chi-Shiung Hsi, LaDawn McIntyre, and Guang Li
5 May 1992 66 p
(Grant NAG1-1301)
(NASA-CR-188477; NAS 1.26:188477) Avail: NTIS HC/MF A04 CSCL 09C

The high T(sub c) superconducting ceramic materials, developed in 1987, are now being extensively investigated for a variety of engineering applications. These applications include such devices as conducting links, rotating and linear bearings, sensors, filters, switches, high Q cavities, magnets, and motors. Some of these devices take advantage of the material's ability to lose all electrical resistance at a critical temperature, T(sub c), while others make use of the repulsion forces generated between the magnetic field of a permanent magnet and a superconductor which is cooled below its T(sub c), Meissner effect. This report describes the work accomplished to date by: (1) reviewing the present state of the art in actuator technology, (2) evaluating processing and fabrication of high strain electrostrictive materials, and (3) testing these electrostrictive materials. For individual titles, see N92-25095 through N92-25097.

N92-25095*# Clemson Univ., SC. Dept. of Ceramic Engineering.
SCREEN PRINTED Y AND BI-BASED SUPERCONDUCTORS
Gene H. Haertling and Chi-Shiung Hsi *In its* Superconductivity Devices: Commercial Use of Space 5 May 1992 26 p (For primary document see N92-25094 15-33)
Avail: NTIS HC/MF A04 CSCL 09C

High T(sub c) superconducting thick film was prepared by screen printing process. Y-based (YBa2Cu3O(7 - x)) superconducting thick films were printed on 211/Al2O3, SNT/Al2O3, and YSZ substrates. Because of poor adhesion of the superconducting thick films to 211/Al2O3 and SNT/Al2O3 substrates, relatively low T(sub c) and J(sub c) values were obtained from the films printed on these substrates. Critical temperatures of YBa2Cu3O(7 - x) thick films deposited on 211/Al2O3 and SNT/Al2O3 substrates were about 80 K. The critical current densities of these films were less than 2 A/cm(exp 2). Higher T(sub c) and J(sub c) films were printed on the YSZ substrates; T(sub c) = 86.4 K and J(sub c) = 50.4 A/cm(exp 2). Multiple lead samples were also prepared on the YSZ substrates. These showed lower T(sub c) and J(sub c) values than plain samples. The heat treatment conditions of the multiple lead samples are still under investigation. Bi-based superconductor thick films have been obtained so far. Improving the superconducting properties of the BSCCO screen printed thick films will be emphasized in future work. Author

N92-25096*# Clemson Univ., SC. Dept. of Ceramic Engineering.
AN ACETATE PRECURSOR PROCESS FOR BSCCO (2223) THIN FILMS AND COPRECIPITATED POWDERS **c25**
Gene H. Haertling *In its* Superconductivity Devices: Commercial Use of Space 5 May 1992 21 p (For primary document see N92-25094 15-33)
Avail: NTIS HC/MF A04 CSCL 09C

Since the discovery of high temperature superconducting oxides much attention has been paid to finding better and useful ways to take advantage of the special properties exhibited by these materials. One such process is the development of thin films for engineering applications. Another such process is the coprecipitation route to producing superconducting powders. An acetate precursor process for use in thin film fabrication and a chemical coprecipitation route to Bismuth based superconducting materials has been developed. Data obtained from the thin film process were inconclusive to date and require more study. The chemical coprecipitation method of producing bulk material is a viable method, and is preferred over the previously used solid state route. This method of powder production appears to be an excellent route to producing thin section tape cast material and screen printed devices, as it requires less calcines than the oxide route to produce quality powders. H.A.

N92-25097*# Clemson Univ., SC. Dept. of Ceramic Engineering.
DEVELOPMENT OF ELECTROSTRICTIVE CERAMIC MOTOR ACTUATORS
Gene H. Haertling and Guang Li *In its* Superconductivity Devices: Commercial Use of Space 5 May 1992 13 p (For primary document see N92-25094 15-33)
Avail: NTIS HC/MF A04 CSCL 09C

Electrostriction, which exists in all materials, exhibits many potential applications in electronic and optically controlled systems. Few materials, however, possess electrostrictive effects large enough to be of practical usefulness. The development of materials with high electrostrictive coefficients has been a major impetus of much research in this area. The Pb(x)Ba(1 - x)(Zr(y)Ti(1 - y))O3 (PBZT) ceramic system appears to be a very promising candidate because of the electrostrictive coefficients, Q(sub 11) and Q(sub 12), are among the highest discovered today. In this paper, we describe the preparation and sintering of the PBZT(73/37) ceramic, and the effect of some sintering conditions on sintered samples. The results on the measurement of the electrostrictive and related properties are presented. In addition, a brief discussion of characteristics of PBZT ceramics is provided. H.A.

N92-25112# Schafer (W. J.) Associates, Inc., Pleasanton, CA.
CONCEPTUAL DESIGN STUDY OF SUPERCONDUCTING MAGNETIC ENERGY STORAGE USING HIGH TEMPERATURE SUPERCONDUCTORS
S. M. Schoenung, W. R. Meier, R. L. Fagaly, M. Heiberger, R. B. Stephens, J. A. Leuer, R. A. Guzman, E. R. Johnson, J. Purcell, and L. Creedon (Advanced CryoMagnetics, Inc., San Diego, CA.) et al Feb. 1992 177 p
(Contract DE-AC02-90CE-34019)
(DE92-007811; DOE/CE-34019/1) Avail: NTIS HC/MF A09

Since the discovery of high critical temperature superconductors (HTS), many predictions have been made for savings in the cost or performance of superconducting technologies for electric utility systems, such as superconducting magnetic energy storage (SMES). The higher operating temperature of HTS materials could mean the use of less expensive cryogens, such as liquid nitrogen, higher refrigeration efficiencies, greater reliability, and easier acceptance within the utility community. While all of these developments may occur, the significance of the improvements depends on the application and other characteristics of the system. Also, today's HTS materials have some negative features, including lower critical current density and greater brittleness, compared to conventional metallic superconductors. A conceptual design for SMES using HTS has been analyzed to determine configuration parameters, refrigeration requirements, and estimated costs of major components. The study covered the energy storage range from 2 to 200 MWh at power levels from 4 to 400 MW. This range includes utility applications from transient and power stabilization to spinning reserve and load leveling. The present assessment has been carried out for cold-supported modular torus and for comparison, a cold-supported modular solenoid. The toroidal configuration was chosen for analysis because it has minimal magnetic field, which could be an advantage in locating a small unit near a utility or customer load. The comparison shows that for all cases, the solenoid is comparable in price or less expensive. However, the solenoid has a varying external magnetic field which must be accommodated. The modular approach was selected primarily as a way to wind the coil and keep the brittle oxide superconductor under compression at all operating conditions to avoid breakage. DOE

N92-25144# Technische Univ., Delft (Netherlands).
SOLID ELECTROLYTE AND SEMICONDUCTOR SO(x) AND NO(x) GAS SENSORS Ph.D. Thesis
Ningling Rao 1991 223 p
(ETN-92-91298) Avail: NTIS HC/MF A10

The preparation, structure, and the thermal, chemical, and electric properties of the solid electrolyte materials Na2SO4, Nasicon, Na(+) beta alumina, and Ag(+) beta alumina are studied. The electrochemical SO(x) (x = 2, 3) gas sensors based in these solid electrolytes were fabricated and tested. Research of the solid electrolyte and semiconductor NO(x) (x = 1, 2) gas sensors was carried out using Ag(+) beta alumina as the solid electrolyte, and Al2O3 ZnO V2O5 mixed oxide semiconductors as the gas sensing materials. ESA

N92-24814*# TRW Space and Defense Sector, Redondo Beach, CA.
LONG DURATION EXPOSURE FACILITY (LDEF) PRELIMINARY FINDINGS: LEO SPACE EFFECTS ON THE SPACE PLASMA-VOLTAGE DRAINAGE EXPERIMENT
Brian K. Blakkolb, James Y. Yaung, Kelly A. Henderson, William W. Taylor, and Lorraine E. Ryan *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 737-752 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 09A

N92-25079*# Lockheed Missiles and Space Co., Sunnyvale, CA.
STEPPER MOTOR INSTABILITIES IN AN AEROSPACE APPLICATION
Russell Kackley and Sean McCully *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 173-187 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 09A

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N92-24206*# MCAT Inst., San Jose, CA.
NUMERICAL STUDIES OF THE FLUID AND OPTICAL FIELDS ASSOCIATED WITH COMPLEX CAVITY FLOWS Progress Report
Christopher A. Atwood Apr. 1992 17 p
(Contract NCC2-677)
(NASA-CR-190295; NAS 1.26:190295; Rept-92-007) Avail: NTIS HC/MF A03 CSCL 20D

Numerical solutions for the flowfield about several cavity configurations have been computed using the Reynolds averaged Navier-Stokes equations. Comparisons between numerical and experimental results are made in two dimensions for free shear layers and a rectangular cavity, and in three dimensions for the transonic aero-window problem of the Stratospheric Observatory for Infrared Astronomy (SOFIA). Results show that dominant acoustic frequencies and magnitudes of the self excited resonant cavity flows compare well with the experiment. In addition, solution sensitivity to artificial dissipation and grid resolution levels are determined. Optical path distortion due to the flow field is modelled geometrically and is found to match the experiment. The fluid field was computed using a diagonalized scheme within an overset mesh framework. An existing code, OVERFLOW, was utilized with the additions of characteristic boundary condition and output routines required for reduction of the unsteady data. The newly developed code is directly applicable to a generalized three dimensional structured grid zone. Details are provided in a paper included in Appendix A. Author

N92-24233 Materials Research Labs., Ascot Vale (Australia).
MODELLING SHORT DURATION SHOCK WAVE ATTENUATION IN EXPLOSIVES
J. A. Waschl and R. Kummer Feb. 1992 18 p
(MRL-TN-597) Copyright Avail: Issuing Activity

The HULL hydrocode is used to predict the shock attenuation within a non-initiating explosive target following thin flyer plate impact. The attenuation relationship between the flyer plate thickness and the initial velocity is investigated. Agreement between HULL predictions and a simple theoretical model is provided. The HULL results may be employed to predict the maximum depth within which initiation may occur. Author

N92-24242*# Rockwell International Science Center, Thousand Oaks, CA.
A USER GUIDE FOR THE EMTAC-MZ CFD CODE Final Report
Kuo-Yen Szema and Sukumar R. Chakravarthy May 1990 64 p
(Contract NAS1-17492)
(NASA-CR-4283; NAS 1.26:4283) Avail: NTIS HC/MF A04 CSCL 20D

The computer code (EMTAC-MZ) was applied to investigate the flow field over a variety of very complex three-dimensional (3-D) configurations across the Mach number range (subsonic, transonic, supersonic, and hypersonic flow). In the code, a finite volume, multizone implementation of high accuracy, total variation diminishing (TVD) formulation (based on Roe's scheme) is used to solve the unsteady Euler equations. In the supersonic regions of the flow, an infinitely large time step and a space-marching scheme is employed. A finite time step and a relaxation or 3-D approximate factorization method is used in subsonic flow regions. The multizone technique allows very complicated configurations to be modeled without geometry modifications, and can easily handle combined internal and external flow problems. An elliptic grid generation package is built into the EMTAC-MZ code. To generate the computational grid, only the surface geometry data are required. Results obtained for a variety of configurations, such as fighter-like configurations (F-14, AVSTOL), flow through inlet, multi-bodies (shuttle with external tank and SRBs), are reported and shown to be in good agreement with available experimental data. Author

N92-24254# Northwestern Univ., Evanston, IL. Dept. of Engineering Sciences and Applied Mathematics.
EFFECTS OF CAPILLARITY ON MICROSCOPIC FLOW IN POROUS MEDIA
Jan. 1992 4 p
(Contract DE-FG02-88ER-13927)
(DE92-007534; DOE/ER-13927/4) Avail: NTIS HC/MF A01

The central theme of this proposal is to study the effects of capillarity on the motion of a fluid interface and to apply these results to flow in porous media. Here we report on several problems considered this year. In particular we have investigated a new similarity solution of a moving boundary problem driven only by surface tension, we have started an investigation on the effect of roughness on the motion of a contact line and we have started both a numerical and analytical investigation of the motion of fluid interfaces in a pore. In addition we report on a new method to derive macroscopic effective equation of motion of two-phase flows at low volume fraction. DOE

N92-24281# Lawrence Livermore National Lab., CA.
RAYLEIGH-TAYLOR INSTABILITY IN COMPRESSIBLE FLUIDS
B. Sturtevant 31 Oct. 1991 21 p Prepared in cooperation with California Inst. of Tech., Pasadena, CA.
(Contract W-7405-eng-48)
(DE92-008578; UCRL-CR-105618-90/91) Avail: NTIS HC/MF A03

We report here the results of a new densitometry technique, based on the differential x ray absorption by the two gases at the

interface. The interface is imaged on x ray negative plates, which are subsequently digitized and analyzed with a newly developed self-calibrating procedure. From the distribution of film density, the density field of the heavy gas (viz. xenon) throughout the test section is reconstructed. The shape of the interface, average density profiles, and density contours are extracted from such density distribution. To our knowledge these are the first measurements of this kind. The technique is demonstrated in a vertical shock tube set up so that a shock of strength M(sub s) = 1.3 interacts with an initially thick (approx. 1 cm) air/xenon interface with a quasi-sinusoidal shape. DOE

N92-24296# Lawrence Livermore National Lab., CA.
FLOW ANALYSIS OF ROLLING CYLINDERS
Sang-Wook Kang Jan. 1992 24 p
(Contract W-7405-eng-48)
(DE92-008403; UCRL-ID-109336) Avail: NTIS HC/MF A03

Preliminary theoretical analysis has been performed of the torque generated due to an infinite cylinder rolling inside another cylinder with a very small gap. Expression for the torque has been obtained in the reference frame of a moving coordinate system. The results show the effects of various parameters such as the rolling speed, the inner-outer cylinder eccentricity and the fluid viscosity. DOE

N92-24344*# High Technology Corp., Hampton, VA.
A THREE-DIMENSIONAL, COMPRESSIBLE, LAMINAR BOUNDARY-LAYER METHOD FOR GENERAL FUSELAGES. VOLUME 2: USER'S MANUAL Final Report
Yong-Sun Wie May 1990 166 p
(Contract NAS1-18240)
(NASA-CR-4292-Vol-2; NAS 1.26:4292-Vol-2) Avail: NTIS HC/MF A08 CSCL 20D

This user's manual contains a complete description of the computer programs developed to calculate three-dimensional, compressible, laminar boundary layers for perfect gas flow on general fuselage shapes. These programs include the 3-D boundary layer program (3DBLC), the body-oriented coordinate program (BCC), and the streamline coordinate program (SCC). Subroutine description, input, output and sample case are discussed. The complete FORTRAN listings of the computer programs are given. Author

N92-24514*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
WORKSHOP ON ENGINEERING TURBULENCE MODELING
Louis A. Povinelli, ed., W. W. Liou, ed., A. Shabbir, ed., and T.-H. Shih, ed. Mar. 1992 510 p Workshop held in Cleveland, OH, 21-22 Aug. 1991
(NASA Order C-99066-G)
(NASA-CP-10088; E-6830; ICOMP-92-02; CMOTT-92-02; NAS 1.55:10088) Avail: NTIS HC/MF A22 CSCL 20D

Discussed here is the future direction of various levels of engineering turbulence modeling related to computational fluid dynamics (CFD) computations for propulsion. For each level of computation, there are a few turbulence models which represent the state-of-the-art for that level. However, it is important to know their capabilities as well as their deficiencies in order to help engineers select and implement the appropriate models in their real world engineering calculations. This will also help turbulence modelers perceive the future directions for improving turbulence models. The focus is on one-point closure models (i.e., from algebraic models to higher order moment closure schemes and partial differential equation methods) which can be applied to CFD computations. However, other schemes helpful in developing one-point closure models, are also discussed. For individual titles, see N92-24515 through N92-24537.

N92-24515*# Manchester Coll. of Science and Technology (England).
TURBULENCE MODELLING IN CFD: PRESENT STATUS, FUTURE PROSPECTS
Brian E. Launder *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 7-16 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

Information is given in viewgraph form for turbulence modeling in computational fluid dynamics (CFD). The Eddy Viscosity Models (EVM), Algebraic Second Moment Closures (ASM), and Differential Second-Moment Closures (DSM) are considered. It is concluded that EVM's, ASM's, and DSM's will remain in use, though with a steady decline in importance of EVM's and ASM's in favor of DSM's. Improved versions of low-Re two-equation EVM's should lead to more reliable predictions of separated flows than are achievable at present. Further refinement of sub-models in second moment closures can be expected throughout this decade. There will be increasing attention given to interfacing SMC with higher order approaches such as LES, and an increased use of two-time-scale schemes providing distinct time scales for large and fairly small eddies. Author

N92-24516*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
COMMENT ON: THE CURRENT STATUS OF TURBULENCE MODELING IN CFD AND ITS FUTURE PROSPECTS
D. M. Bushnell *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 17-37 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

Information is given in viewgraph form on computational fluid dynamics (CFD). Topics covered include the fundamental problem with conventional turbulence modeling, the fundamental problems with the state-of-the-art turbulence modeling approach of 'eddy viscosity', major problems with Reynolds stress equation (RSE) closures, RSE challenges that are probably addressable within the context of Reynolds averaging, RSE challenges which may require theoretical/numerical spectral adjuncts for satisfactory solutions, tools available to aid RSE modeling, and a simplex view of the status of turbulence modeling. Author

N92-24517*# DCW Industries, La Canada, CA.
THE PRESENT STATE AND THE FUTURE DIRECTION OF EDDY VISCOSITY MODELS
David C. Wilcox *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 39-70 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

Information is given in viewgraph form on the present state and future direction of eddy viscosity models. Topics covered include the eddy viscosity dilemma, two-equation models, equations of motion, free shear flows, incompressible free shear flows, model-predicted boundary layer structure, defect layer analysis, the effects of pressure gradients, viscous sublayer structure, wall functions and viscous damping, viscous damping for kappa-omega, the effects of compressibility, perturbation analysis of the wall layer, an alternative compressibility term, unsteady boundary layers, incompressible separation, backstep results, and compressible separation. Author

N92-24518*# Boeing Commercial Airplane Co., Seattle, WA.
COMMENT PAPER: WORKSHOP ON ENGINEERING TURBULENCE MODELING
P. R. Spalart *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 71-77 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

The speaker for this paper describes and evaluates a k-epsilon model for calculating Samuel-Joubert flow. He proceeds to present both Boeing's and his positions on the state-of-the-art in this area and future goals. Finally, presented is a one equation mathematical model for calculating Samuel-Joubert flow. All results are presented in viewgraph format. H.A.

N92-24519*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMMENT ON: THE PRESENT STATE AND FUTURE DIRECTION OF EDDY VISCOSITY MODELS
T. J. Coakley *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 79-86 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

Two turbulence models are compared under various flow conditions. Presented first is a k-omega model which is best suited for wall bounded flows. Presented second is a k-epsilon model which is best suited for free shear flow. Generalizations of the k-omega model are discussed, and various aerodynamic parameters such as skin friction, velocity distribution, and hypersonic cylinder-flare, are compared for the different models. All results are presented in viewgraph format. H.A.

N92-24520*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
COMMENT ON TWO-EQUATION MODELS
N. Lang and T. Chitsomboon *In its* Workshop on Engineering Turbulence Modeling Mar. 1992 p 87-99 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

Several turbulence models are studied and evaluated. All models are compared to each other and experimental values for flat plate boundary layer flow and channel flow. Among the models examined are: K-epsilon, k-omega, q-omega, and k-tau turbulence models. All results are presented in viewgraph format. H.A.

N92-24521*# Buffalo Univ., NY.
THE PRESENT STATUS AND FUTURE DIRECTION OF ALGEBRAIC REYNOLDS STRESS MODELS
Dale B. Taulbee *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 101-144 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

The need for algebraic models and deficiencies of linear gradient models are presented. Classical algebraic Reynolds stress models are discussed with nonlinear stress-strain relations. Finally, the models are critiqued and some new developments are shown. All results are in viewgraph format. H.A.

N92-24522*# Old Dominion Univ., Norfolk, VA.
THE PRESENT STATUS AND FUTURE DIRECTION OF ALGEBRAIC REYNOLDS STRESS MODELS: COMMENT ON
A. O. Demuren *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 145-159 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

A number of algebraic stress models are presented and evaluated. These models are then compared to each other as well as to experimental data for three different flow conditions. Finally, the limitations of the models are examined in the presence of curvature, rotation/swirl, gravitation/body forces, and streamwise corners. All results are presented in viewgraph format. H.A.

N92-24523*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE PRESENT STATUS AND THE FUTURE DIRECTION OF SECOND ORDER CLOSURE MODELS FOR INCOMPRESSIBLE FLOWS
T.-H. Shih *In its* Workshop on Engineering Turbulence Modeling Mar. 1992 p 163-217 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

The topics are covered in viewgraph form and include: (1) basic equations and model terms; (2) model constraints and assumptions; (3) the present state of various closure models; and (4) future directions. K.S.

N92-24524*# Cornell Univ., Ithaca, NY.
SECOND ORDER TURBULENCE SIMULATION OF THE ROTATING, BUOYANT, RECIRCULATING CONVECTION IN THE CZOCHRALSKI CRYSTAL MELT Thesis
J. R. Ristorcelli *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 219-228 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

The topics are presented in viewgraph form and include: (1) a problem statement; (2) the rapid pressure models tested (both linear and nonlinear); (3) the computational problem; and (4) shortcomings and future work. K.S.

N92-24525*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
COMMENTS ON THE PRESENT STATE OF SECOND-ORDER CLOSURE MODELS FOR INCOMPRESSIBLE FLOWS
Charles G. Speziale *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 229-247 Sponsored by NASA. Langley Research Center (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

Second-order closure models account for history and nonlocal effects of the mean velocity gradients on the Reynolds stress tensor. Turbulent flows involving body forces or curvature, Reynolds stress relaxational effects, and counter-gradient transport are usually better described. The topics are presented in viewgraph form and include: (1) the Reynolds stress transport equation; (2) issues in second-order closure modeling; and (3) near wall models. Author

N92-24526*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THE PRESENT STATE AND FUTURE DIRECTION OF SECOND ORDER CLOSURE MODELS FOR COMPRESSIBLE FLOWS
Thomas B. Gatski, Sutanu Sarkar, and Charles G. Speziale (Institute for Computer Applications in Science and Engineering, Hampton, VA.) *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 249-275 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

The topics are presented in viewgraph form and include: (1) Reynolds stress closure models; (2) Favre averages and governing equations; (3) the model for the deviatoric part of the pressure-strain rate correlation; (4) the SSG pressure-strain correlation model; (5) a compressible turbulent dissipation rate model; (6) variable viscosity effects; (7) near-wall stiffness problems; (8) models of the Reynolds mass and heat flux; and (9) a numerical solution of the compressible turbulent transport equation. K.S.

N92-24527*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
COMMENT ON: THE PRESENT STATE AND FUTURE DIRECTION OF SECOND-ORDER CLOSURE MODELS FOR COMPRESSIBLE FLOWS
J. R. Viegas and P. G. Huang (Eloret Corp., Moffett Field, CA.) *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 277-300 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

The topics are presented in viewgraph form and include: (1) an alternative relaxed strain energy (RSE) model; (2) shear layers/spread rate comparisons; (3) general comments on RSE models; and (4) the law of the wall. K.S.

N92-24528*# Cornell Univ., Ithaca, NY.
THE PRESENT STATE AND FUTURE DIRECTIONS OF PDF METHODS
S. B. Pope *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 301-326 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

The objectives of the workshop are presented in viewgraph

format, as is this entire article. The objectives are to discuss the present status and the future direction of various levels of engineering turbulence modeling related to Computational Fluid Dynamics (CFD) computations for propulsion; to assure that combustion is an essential part of propulsion; and to discuss Probability Density Function (PDF) methods for turbulent combustion. Essential to the integration of turbulent combustion models is the development of turbulent model, chemical kinetics, and numerical method. Some turbulent combustion models typically used in industry are the k-epsilon turbulent model, the equilibrium/mixing limited combustion, and the finite volume codes. E.R.

N92-24529*# State Univ. of New York, Stony Brook.
COMMENTS ON THE PRESENT STATE AND FUTURE DIRECTIONS OF PDF METHODS
E. E. OBrien *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 327-335 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

The one point probability density function (PDF) method is examined in light of its use in actual engineering problems. The PDF method, although relatively complicated, appears to be the only format available to handle the nonlinear stochastic difficulties caused by typical reaction kinetics. Turbulence modeling, if it is to play a central role in combustion modeling, has to be integrated with the chemistry in a way which produces accurate numerical solutions to combustion problems. It is questionable whether the development of turbulent models in isolation from the peculiar statistics of reactant concentrations is a fruitful line of development as far as propulsion is concerned. There are three issues for which additional viewgraphs are prepared: the one point pdf method; the amplitude mapping closure; and a hybrid strategy for replacing a full two point pdf treatment of reacting flows by a single point pdf and correlation functions. An appeal is made for the establishment of an adequate data base for compressible flow with reactions for Mach numbers of unity or higher. Author

N92-24530*# Sandia National Labs., Albuquerque, NM. Combustion Research Facility.
COMMENTS ON PDF METHODS
J.-Y. Chen *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 337-350 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

Viewgraphs are presented on the following topics: the grand challenge of combustion engineering; research of probability density function (PDF) methods at Sandia; experiments of turbulent jet flames (Masri and Dibble, 1988); departures from chemical equilibrium; modeling turbulent reacting flows; superequilibrium OH radical; pdf modeling of turbulent jet flames; scatter plot for CH4 (methane) and O2 (oxygen); methanol turbulent jet flames; comparisons between predictions and experimental data; and turbulent C2H4 jet flames. E.R.

N92-24531*# Rockwell International Corp., Canoga Park, CA. Rocketdyne Div.
SOME COMMENTS ON TURBULENCE MODELING FROM AN INDUSTRIAL PERSPECTIVE
Munir M. Sindir *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 351-358 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

In propulsion industry, computational techniques (namely computational fluid dynamics) are gradually becoming engineering design and analysis tools, especially in the case of high performance aircraft engines, high speed air breathing propulsion, rocket propulsion, and advanced nuclear propulsion and electric propulsion. The key issues in acceptance of CFD are turn around time, cost, and accuracy. The turn around time of analysis has to fit program schedules. Cost is still the bottom line, the value of CFD to the program should at least balance its cost. CFD can be used if it can be divided into two major parts: numerics and physical models. Author

N92-24532*# Tokyo Univ. (Japan). Inst. of Industrial Science.
THE PRESENT STATE OF DIA MODELS AND THEIR IMPACT ON ONE POINT CLOSURES
Akira Yoshizawa *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 361-389 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

An outline is presented of the DIA model. Another outline is presented of TSDIA (two scale DIA) and some suggestions for turbulence modeling. Two proposals are made: helicity for the study of the effects of swirling flow and cross flow; and density variance for the study of highly compressed flows. Author

N92-24533*# National Oceanic and Atmospheric Administration, Boulder, CO.
PRESENT STATE OF TWO-POINT CLOSURES AND THEIR IMPACT ON SINGLE-POINT CLOSURES
Jerry Weinstock *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 391-407 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

A radical simplification to be used in the solution of single-point closures is presented. The results provide a nonlinear description of the growth of turbulence. Author

N92-24534*# Princeton Univ., NJ.
THE PRESENT STATE OF RNG AND ITS IMPACT ON ONE-POINT CLOSURE
S. Orszag *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 409-433 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

The use of renormalization group methods in one-point closure problems is discussed. This material is directly relevant to the production of K-epsilon turbulence models. Author

N92-24535*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
THE PRESENT STATE OF USING RDT IN TURBULENCE MODELLING OF UNSTEADY FLOWS
Reda R. Mankbadi *In its* Workshop on Engineering Turbulence Modeling Mar. 1992 p 435-461 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

The dissipation transport equation should not be based upon the local-equilibrium hypothesis, but should instead be based upon the rapid-distortion hypothesis. A differential equation to describe this situation is not currently available. An investigation of this topic is presented in viewgraph form. Author

N92-24536*# State Univ. of New York, Buffalo. Turbulence Research Lab.
THE ROLE OF EXPERIMENTS IN TURBULENCE MODELLING
William K. George *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 463-485 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

Current dilemmas in experimental fluid dynamics are discussed in the context of their relevance to ongoing and future work in computational fluid dynamics. Among the topics discussed are the following: (1) the round jet; (2) the turbulent boundary layer; (3) the plane wake; and (4) the dissipation. Author

N92-24537*# Stanford Univ., CA.
NUMERICAL SIMULATION: ITS CONTRIBUTIONS TO TURBULENCE MODELING
Joel H. Ferziger *In* NASA. Lewis Research Center, Workshop on Engineering Turbulence Modeling Mar. 1992 p 487-521 (For primary document see N92-24514 15-34)
Avail: NTIS HC/MF A22 CSCL 20D

The relative advantages and disadvantages of Direct Numerical Simulation (DNS) and Large Eddy Simulation (LES) are discussed. The topics are presented in viewgraph form. Author

N92-24547* High Technology Corp., Hampton, VA.
A THREE-DIMENSIONAL, COMPRESSIBLE, LAMINAR BOUNDARY-LAYER METHOD FOR GENERAL FUSELAGES. VOLUME 1: NUMERICAL METHOD Final Report
Yong-Sun Wie May 1990 117 p
(Contract NAS1-18240)
(NASA-CR-4292-Vol-1; NAS 1.26:4292-Vol-1) Avail: NTIS HC/MF A06 CSCL 20D

A procedure for calculating 3-D, compressible laminar boundary layer flow on general fuselage shapes is described. The boundary layer solutions can be obtained in either nonorthogonal 'body oriented' coordinates or orthogonal streamline coordinates. The numerical procedure is 'second order' accurate, efficient and independent of the cross flow velocity direction. Numerical results are presented for several test cases, including a sharp cone, an ellipsoid of revolution, and a general aircraft fuselage at angle of attack. Comparisons are made between numerical results obtained using nonorthogonal curvilinear 'body oriented' coordinates and streamline coordinates. Author

N92-24705# Westinghouse Savannah River Co., Aiken, SC.
MEASUREMENT OF TWO-COMPONENT FLOW USING ULTRASONIC FLOWMETERS
J. C. Whitehouse, D. A. Eghbali, V. E. Flitton, and D. G. Anderson (Wyle Labs., Inc., Norco, CA.) 1991 5 p Presented at the American Society of Mechanical Engineers (ASME) Annual Winter Meeting, Atlanta, GA, 1-6 Dec. 1991
(Contract DE-AC09-89SR-18035)
(DE92-010099; WSRC-MS-91-261; CONF-911213-23) Avail: NTIS HC/MF A01

Calibration of transit-time and Doppler ultrasonic flowmeters under two-component flow conditions has been conducted on 400 mm (16-in.) pipe. Testing covered total flows of 0.19 to 1.89 m(exp 3)/s (3000 to 30,000 gpm) and void fractions up to 40 percent. Both flowmeter types accurately measured total volumetric flow over a portion of their ranges. Pipe average void fraction, based on a three-beam gamma densitometer, was used to determine water component flow under stratified flow conditions, with similar results. DOE

N92-24709*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
INTERACTION OF DISTURBANCES WITH AN OBLIQUE DETONATION WAVE ATTACHED TO A WEDGE Final Report
D. G. Lasseigne (Old Dominion Univ., Norfolk, VA.) and M. Y. Hussaini Mar. 1992 32 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-189624; NAS 1.26:189624; ICASE-92-11) Avail: NTIS HC/MF A03 CSCL 20D

The linear response of an oblique overdriven detonation to impose free stream disturbances or to periodic movements of the wedge is examined. The free stream disturbances are assumed to be steady vorticity waves and the wedge motions are considered to be time periodic oscillations either about a fixed pivot point or along the plane of symmetry of the wedge aligned with the incoming stream. The detonation is considered to be a region of infinitesmal thickness in which a finite amount of heat is released. The response to the imposed disturbances is a function of the Mach number of the incoming flow, the wedge angle, and the exothermocity of the reaction within the detonation. It is shown that as the degree of overdrive increases, the amplitude of the response increases significantly; furthermore, a fundamental difference in the dependence of the response on the parameters of the problem is found between the response to a free stream disturbance and to a disturbance emanating from the wedge surface. Author

N92-24797*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A SIMPLIFIED METHOD FOR THERMAL ANALYSIS OF A COWL LEADING EDGE SUBJECT TO INTENSE LOCAL SHOCK-WAVE-INTERFERENCE HEATING
David M. McGowan, Charles J. Camarda, and Stephen J. Scotti Washington Mar. 1992 40 p
(NASA-TP-3167; L-16505; NAS 1.60:3167) Avail: NTIS HC/MF A03 CSCL 20D

Type IV shock wave interference heating on a blunt body causes extremely intense heating over a very localized region of the body. An analytical solution is presented to a heat transfer problem that approximates the shock wave interference heating of an engine cowl leading edge of the National Aero-Space Plane. The problem uses a simplified geometry to represent the leading edge. An analytical solution is developed that provides a means for approximating maximum temperature differences between the outer and inner surface temperatures of the leading edge. The solution is computationally efficient and, as a result, is well suited for conceptual and preliminary design or trade studies. Transient and steady state analyses are conducted, and results obtained from the analytical solution are compared with results of 2-D thermal finite element analyses over a wide range of design parameters. Isotropic materials as well as laminated composite materials are studied. Results of parametric studies are presented to indicate the effects of the thickness of the cowl leading edge and the width of the region heated by the shock wave interference on the thermal response of the leading edge. Author

N92-24895# Argonne National Lab., IL. Reactor Engineering Div.
DYNAMIC RESPONSE OF A TANK CONTAINING TWO LIQUIDS
Yu Tang and Yao Chang Feb. 1992 38 p
(Contract W-31-109-eng-38)
(DE92-008914; ANL/RE-92/1) Avail: NTIS HC/MF A03

A study on the dynamic response of upright circular cylindrical liquid-storage tanks containing two different liquids under a horizontal base motion with arbitrary temporal variation is presented. Both rigid and flexible tanks are studied. The response functions examined include the base shear, base moments, and hydrodynamic pressure on the tank wall and base. Unlike the cases of tanks containing one liquid in which the response is controlled by one parameter, the responses of tanks that contain two different liquids are controlled by three parameters. For rigid tanks, the response functions are evaluated for a wide range of values for each parameter; the results are presented in tabular and graphic forms. The responses of flexible tanks containing two liquids are evaluated by an approximate approach which is an extension of the method used for evaluation of response functions for flexible tanks that contain only one liquid. DOE

N92-24902# Iowa Univ., Iowa City. Inst. of Hydraulic Research.
LEONARDIAN FLUID MECHANICS. PART 1: HISTORY OF KINEMATICS. PART 2: INCEPTION OF MODERN KINEMATICS
E. Macagno Aug. 1991 142 p Sponsored in part by NSF, Washington, DC; and National Endowment for the Humanities, Washington, DC
(PB92-146109; IIHR-MONO-112) Avail: NTIS HC/MF A07 CSCL 20D

A history of kinematics is given. Empirical kinematics, theoretical kinematics, experimental kinematics, the inception of modern kinematics, kinematics before and after Ampere, and Ampere's contribution are discussed. Author

N92-24972*# Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
FLUID MECHANICS EXPERIMENTS IN OSCILLATORY FLOW. VOLUME 1: REPORT Final Report
J. Seume, G. Friedman, and T. W. Simon Mar. 1992 160 p
(Grant NAG3-598)
(NASA-CR-189127; NAS 1.26:189127) Avail: NTIS HC/MF A08 CSCL 20D

Results of a fluid mechanics measurement program in oscillating flow within a circular duct are presented. The program began with a survey of transition behavior over a range of oscillation frequency and magnitude and continued with a detailed study at a single operating point. Such measurements were made in support of Stirling engine development. Values of three dimensionless parameters, Re(sub max), Re(sub w), and A(sub R), embody the velocity amplitude, frequency of oscillation and mean fluid displacement of the cycle, respectively. Measurements were first made over a range of these parameters which included operating points of all Stirling engines. Next, a case was studied with values of these parameters that are representative of the heat exchanger tubes in the heater section of NASA's Stirling cycle Space Power Research Engine (SPRE). Measurements were taken of the axial and radial components of ensemble-averaged velocity and rms-velocity fluctuation and the dominant Reynolds shear stress, at various radial positions for each of four axial stations. In each run, transition from laminar to turbulent flow, and its reverse, were identified and sufficient data was gathered to propose the transition mechanism. Models of laminar and turbulent boundary layers were used to process the data into wall coordinates and to evaluate skin friction coefficients. Such data aids in validating computational models and is useful in comparing oscillatory flow characteristics to those of fully-developed steady flow. Data were taken with a contoured entry to each end of the test section and with flush square inlets so that the effects of test section inlet geometry on transition and turbulence are documented. Volume 1 contains the text of the report including figures and supporting appendices. Volume 2 contains data reduction program listings and tabulated data (including its graphical presentation). Author

N92-25029# Institute of Gas Technology, Chicago, IL.
DETERMINATION OF FLOW-REGIME BOUNDARIES FOR COHESIVE PARTICLES
T. M. Knowlton and J. G. Findlay Jan. 1992 51 p
(Contract DE-AC22-88PC-88951)
(DE92-008636; DOE/PC-88951/10) Avail: NTIS HC/MF A04

The overall objective of this program is the development of a hydrodynamic model to predict the choking/non-choking flow regime boundary of fine, cohesive (i.e., Geldart Group C) powders. Specific objectives are to: (1) Develop a two-dimensional hydrodynamic model that can be applied to cohesive solids; and (2) Generate large-scale solids-flows data that will be used to verify the model. DOE

N92-25123# Lawrence Livermore National Lab., CA.
DETERMINATION OF VELOCITY VECTORS IN POROUS MEDIA WITH FLUORESCENT PARTICLE IMAGE VELOCIMETRY (FPIV)
M. A. Northrup, T. J. Kulp, S. M. Angel, and G. F. Pinder Feb. 1991 17 p Presented at the The Nato-Advanced Study Institute on Convective Heat and Mass Transfer in Porous Media, Izmir, Turkey, 6-17 Aug. 1990
(Contract W-7405-eng-48)
(DE92-008597; UCRL-JC-105044; CONF-9008240-1) Avail: NTIS HC/MF A03

Fluorescent particle image velocimetry (FPIV) is used in conjunction with refractive-index-matching to measure flow velocities in the interstitial regions of a porous medium. Adaptations that allow the use of conventional PIV methodology in index-matched systems are discussed, and the results of flow field measurements in a porous test bed under saturated flow conditions are presented. Preliminary analysis of these data, in which the horizontal and vertical components of the interstitial velocity vectors were averaged over a specified region within the medium, are also presented and compared with the predictions obtained from the total volumetric flow rate. The macroscopically derived and FPIV measured values are found to be in close agreement. In general, our results demonstrate the utility of the FPIV technique to determine both the point velocity and the local volume-averaged velocity within porous media. DOE

N92-25136*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
ON TURBULENT SPOTS IN PLANE POISEUILLE FLOW
Dan S. Henningson (Massachusetts Inst. of Tech., Cambridge.) and John Kim Feb. 1992 40 p Previously announced in IAA as A91-48280 Submitted for publication Original contains color illustrations
(NASA-TM-102836; A-90192; NAS 1.15:102836) Avail: NTIS HC/MF A03; 2 functional color pages CSCL 20D

Turbulence characteristics inside a turbulent spot in plume Poiseuille flow are investigated by analyzing a data base obtained from a direct numerical simulation. The spot is found to consist of two distinct regions - a turbulent area and a wave area. The flow inside the turbulent area has a strong resemblance to that found in the fully developed turbulent channel. Suitably defined mean and rms fluctuations as well as the internal shear layer structures are found to be similar to the turbulent counterpart. In the wave area, the inflexional mean spanwise profiles cause a rapid growth of oblique waves, which break down to turbulence. The breakdown process of the oblique waves is reminiscent of the secondary instability observed during transition to turbulence in channel and boundary layer flows. Other detailed characteristics associated with the Poiseuille spot are presented and are compared with experimental results. Author

N92-24339# National Aeronautical Lab., Bangalore (India). Jawaharlal Nehru Center for Advanced Scientific Research.
THE DYNAMICS OF THE TRANSITION ZONE AND ITS MODELING
R. Narasimha *In* VKI, Boundary Layers in Turbomachines 1991 100 p (For primary document see N92-24336 15-07)
Avail: NTIS HC/MF A21

N92-24341# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
BOUNDARY LAYERS AND TRANSITION ON CONCAVE SURFACES
R. I. Crane *In* VKI, Boundary Layers in Turbomachines 1991 47 p (For primary document see N92-24336 15-07)
Avail: NTIS HC/MF A21

N92-24342# Advanced Scientific Computing G.m.b.H., Holzkirchen (Germany, F.R.).
NUMERICAL PREDICTION OF BOUNDARY LAYERS AND TRANSITIONAL FLOWS
Georg Scheuerer *In* VKI, Boundary Layers in Turbomachines 1991 73 p (For primary document see N92-24336 15-07)
Avail: NTIS HC/MF A21

N92-24343# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
BOUNDARY LAYER TRANSITION UNDER THE PRESENCE OF DISCRETE FREQUENCIES IN THE FREESTREAM TURBULENCE SPECTRUM
Jorge Costa and Tony Arts *In its* Boundary Layers in Turbomachines 1991 46 p (For primary document see N92-24336 15-07)
Avail: NTIS HC/MF A21

N92-24386# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Leichtbau.
DYNOST: DYNAMICS OF SURFACE TENSION TANKS [DYNOST: DYNAMIK VON OBERFLAECHENSPANNUNGSTANKS]
A. Rittweger *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 91-92 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24392# Gesamthochschule, Essen (Germany, F.R.). Lehrstuhl fuer Stroemungslehre.
INTERACTION BETWEEN SHOCK WAVE AND TUBULAR FLOW [WECHSELWIRKUNG ZWISCHEN EINER STOSSWELLE UND EINER TURBULENTEN STROEMUNG]
W. Merzkirch *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 107 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24873# Defence Research Establishment Suffield, Ralston (Alberta).
BOUNDARY LAYER COMPUTATIONS USING A GENERALIZED FORMULATION
D. Bergeron and D. W. Zingg *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 365-378 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

N92-24874# Canadian Forces Headquarters, Ottawa (Ontario).
THE EFFECT OF DROPLET SIZING UNCERTAINTY ON ICE ACCRETIONS
Robert G. Foster and C. Scott Bartlett (Arnold Engineering Development Center, Arnold Air Force Station, TN.) *In* CASI, Proceedings of the 3rd Canadian Symposium on Aerodynamics 1991 p 379-391 (For primary document see N92-24849 15-02)
Avail: Canadian Aeronautics and Space Inst., 222 Somerset St. W., Suite 601, Ottawa, ON K2P 0J1 Canada

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N92-24204*# Amerasia Technology, Inc., Westlake Village, CA.
ONE GHz DIGITIZER FOR SPACE BASED LASER ALTIMETER Final Report, Apr. 1989 - Aug. 1991
Edward J. Staples 16 Oct. 1991 107 p
(Contract NAS5-30626)
(NASA-CR-190301; NAS 1.26:190301; SR0130-9) Avail: NTIS HC/MF A06 CSCL 14B

This is the final report for the research and development of the one GHz digitizer for space based laser altimeter. A feasibility model was designed, built, and tested. Only partial testing of essential functions of the digitizer was completed. Hybrid technology was incorporated which allows analog storage (memory) of the digitally sampled data. The actual sampling rate is 62.5 MHz, but executed in 16 parallel channels, to provide an effective sampling rate of one GHz. The average power consumption of the one GHz digitizer is not more than 1.5 Watts. A one GHz oscillator is incorporated for timing purposes. This signal is also made available externally for system timing. A software package was also developed for internal use (controls, commands, etc.) and for data communication with the host computer. The digitizer is equipped with an onboard microprocessor for this purpose.
Author

N92-24231 Materials Research Labs., Ascot Vale (Australia).
A VISAR VELOCITY INTERFEROMETER SYSTEM AT MRL FOR SLAPPER DETONATOR AND SHOCKWAVE STUDIES
David J. Hatt Dec. 1991 49 p
(MRL-TR-91-42) Copyright Avail: Issuing Activity

This report describes the commissioning and appraisal of a conventional 3-detector VISAR velocity interferometer system for measuring the velocity time histories of small plastic flyer plates produced by exploding bridge foil generators. Proper treatment of the flyer surface to diffusely reflect the laser beam was found to be important. Roughening the surface with a miniature grit-blaster produced the best results. Peak velocities in the range of 1500 m/sec to 3900 m/sec were obtained for small and medium scale flyers. Accelerations were in the range of 10 Gm/sec to 100 Gm/sec. The uncertainty of the measurements was found to be related to the limited high frequency response of the photodetectors. After replacement of the original non-flat beamsplitter, the arms of the interferometer were not quite compensated. A modified VISAR velocity equation that allows for the effective etalon length of the lambda/8 waveplate/beamsplitter combination is derived.
Author

N92-24692# Los Alamos National Lab., NM.
SILICON-BASED TRACKING SYSTEM: MECHANICAL ENGINEERING AND DESIGN
W. O. Miller, M. T. Gamble, T. C. Thompson, K. A. Woloshun, R. S. Reid, J. A. Hanlon, F. D. Michaud, G. D. Dransfield, H. J. Ziock, and A. P. Palounek 1992 8 p Presented at the International Industrial Symposium on the Super Collider, New Orleans, LA, 4-6 Mar. 1992
(Contract W-7405-eng-36)
(DE92-008477; LA-UR-92-692; CONF-920331-1) Avail: NTIS HC/MF A02

The Silicon Tracking System (STS) is composed of silicon strip detectors arranged by both in a cylindrical array and an array of flat panels about the interaction region. The cylindrical array is denoted the central region and the flat panel arrays, which are normal to the beam axis, we denoted the forward regions. The overall length of the silicon array is 5.16 m and the maximum diameter is 0.93 m. The Silicon Tracking System Conceptual Design Report, should be consulted for the body of analysis performed to quantify the present design concept. For the STS to achieve its physics goals, the mechanical structures and services must support 17 sq m of silicon detectors and stabilize their positions to within 5 microns, uniformly cool the detector the system to O C and at the same time potentially remove up to 13 kW of waste heat generated by the detector electronics, provide up to 3400 A of current to supply the 6.5 million electronics channels, and supply of control and data transmission lines for those channels. These objectives must be achieved in a high ionizing radiation environment, using virtually no structural mass and only low z materials. The system must be maintainable during its 10 year operating life.
DOE

N92-24881*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MULTIWAVELENGTH PYROMETRY FOR NONGRAY BODIES
Daniel Ng Feb. 1992 11 p
(NASA-TM-105285; E-6616; NAS 1.15:105285) Avail: NTIS HC/MF A03 CSCL 14B

A multiwavelength technique was developed and applied to measure the temperatures of nongray surfaces. The instruments required are a spectral radiometer, a dedicated auxiliary radiation source, and a computer. In general, three radiation spectra are recorded: (1) spectrum S sub 0 of the auxiliary radiation source; (2) spectrum S sub 1 of the surface-emitted radiation; and (3) spectrum S sub 2, the sum of the radiation of S sub 1 plus the reflected radiation due to the incidence of the auxiliary radiation source on the surface. Subtracting spectrum S sub 1 from spectrum Sub 2 yields the reflection spectrum resulting from the incidence radiation. From these spectra, a quantity z(lambda) is derived and is related to the reflectivity r(lambda) by r(lambda) = z(lambda)/f, where f is a constant. Spectrum S sub 1 is represented mathematically as the product of a wavelength-dependent emissivity obtained from Kirchhoff's law and a Planck function of temperature T. Application of two-variable (lambda and z), nonlinear, least-squares curve-fitting computer software to fit spectrum S sub 1 to this mathematical expression yielded the surface temperature. This technique also measured the spectral

reflectivity and emissivity of the surface. Instrumentation necessary to extend measurement to elevated temperatures and in the presence of reflective interference is discussed. Author

N92-24959*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DESCRIPTION OF A PRESSURE MEASUREMENT TECHNIQUE FOR OBTAINING SURFACE STATIC PRESSURES OF A RADIAL TURBINE
L. Danielle DiCicco, Brent C. Nowlin, and Lizet Tirres (Sverdrup Technology, Inc., Brook Park, OH.) 1992 11 p Proposed for presentation at the 17th Aerospace Ground Testing Conference, Nashville, TN, 6-8 Jul. 1992; sponsored by AIAA
(NASA-TM-105643; E-6989; NAS 1.15:105643; AIAA-92-4006)
Avail: NTIS HC/MF A03 CSCL 14B

The aerodynamic performance of a solid uncooled version of a cooled radial turbine was evaluated in the Small Engine Components Test Facility Turbine rig at the NASA Lewis Research Center. Specifically, an experiment was conducted to rotor surface static pressures. This was the first time surface static pressures had been measured on a radial turbine at NASA Lewis. These pressures were measured by a modified Rotating Data Package (RDP), a standard product manufactured by Scanivalve, Inc. Described here are the RDP, and the modifications that were made, as well as the checkout, installation, and testing procedures. The data presented are compared to analytical results obtained from NASA's MERIDL TSONIC BLAYER (MTSB) code. Author

N92-25034# Sandia National Labs., Albuquerque, NM.
AN EVALUATION OF INTENSIFIED SOLID-STATE VIDEO CAMERAS
D. A. Greenwoll Nov. 1991 60 p
(Contract DE-AC04-76DP-00789)
(DE92-009556; SAND-90-2566) Avail: NTIS HC/MF A04

This report discusses the laboratory and field testing of four intensified solid-state imager closed-circuit television cameras suitable for perimeter video assessment systems. The first and second generation intensifier cameras were evaluated for sensitivity, resolution, and image quality in day-to-night natural illumination levels. DOE

N92-25050# Sandia National Labs., Albuquerque, NM.
OBSERVATIONS OF THE SHOCK RESPONSE OF SPECIFIC PIEZO RESISTIVE ACCELEROMETERS
R. A. Benham and B. D. Duggins 1992 11 p Presented at the 38th Illuminating Engineering Society (IES) Annual Technical Meeting and Exposition, Nashville, TN, 3-8 May 1992
(Contract DE-AC04-76DP-00789)
(DE92-008684; SAND-92-0231C; CONF-9205104-1) Avail: NTIS HC/MF A03

Pyro shock loads are generated in many missile or rocket systems when stages are separated or shrouds are removed. These shocks are localized, of short rise time (10's of nanoseconds) and of very high stress level. This paper will document some anomalous behavior that occurs when pyro shock accelerometers (Endevco 7270A) are exposed to levels of high frequency shock that is higher than the manufacturer's recommended limits. Such shocks occur in many pyro shock events. Standard, accepted recording techniques can produce totally erroneous data with no obvious indicator that the data is in error. Wide band data recording, along with Fourier Analysis of the data, and dynamic analysis, made by the gage manufacturer of the transducer, allow recognition of some of the non-standard response modes excited but no method of quantifying the corrupted data has been developed. Wide band recording, which will preserve the data in the gage resonance range and above, are required to insure understanding of these pyro shock events. DOE

N92-24317*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
AN ASSEMBLY TO PROVIDE A TIME REFERENCE FOR THE JPL NETWORK OPERATIONS CONTROL CENTER, REAL-TIME
P. A. Clements, J. G. Lopez, and M. J. Kelley (Telos Corp., Pasadena, CA.) *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 214-221 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 14B

N92-24319*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
A MICROWAVE HOLOGRAPHY METHODOLOGY FOR DIAGNOSTICS AND PERFORMANCE IMPROVEMENT FOR LARGE REFLECTOR ANTENNAS
D. J. Rochblatt *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 235-252 Original contains color illustrations (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 14E

N92-24320*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
PERFORMANCE IMPROVEMENT OF DSS-13 34-METER BEAM-WAVEGUIDE ANTENNA USING THE JPL MICROWAVE HOLOGRAPHY METHODOLOGY
D. J. Rochblatt and B. L. Seidel *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 253-270 Original contains color illustrations (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 14E

N92-24363# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
DEVELOPMENT OF A SUBMILLIMETER/FAR INFRARED HETERODYNE SPECTROMETER: TESTING ON SPACECRAFT AS A PREPARATION FOR THE FIRST PROJECT [ENTWICKLUNG EINES SUBMM/FIR-HETERODYN-SPEKTROMETERS; ERPROBUNG MIT ASTROFLUGZEUGEN ZUR VORBEREITUNG AUF FIRST]
P. G. Metzger *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 41-42 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24623# Forschungszentrum Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Atmosphaerische Chemie.
A NEW BALLOON BORNE STRATOSPHERIC HYGROMETER
U. Moerschel, E. Klein, D. Kley, and U. Schmidt *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 201-205 Sponsored in part by BMFT (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24624# Karlsruhe Univ. (Germany, F.R.). Inst. fuer Meteorologie und Klimaforschung.
REMOTE SENSING OF TRACE GASES WITH A BALLOON BORNE VERSION OF THE MICHELSON INTERFEROMETER FOR PASSIVE ATMOSPHERIC SOUNDING (MIPAS)
H. Oelhaf, T. v.Clarmann, F. Fergg, H. Fischer, F. Friedl-Vallon, C. Fritzsche, C. Piesch, D. Rabus, M. Seefeldner, and W. Voelker (Technische Univ., Munich, Germany, F.R.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 207-213 (For primary document see N92-24589 15-12)
(Contract BMFT-ATP-04)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-25007 North Carolina Central Univ., Durham. Dept. of Physics.
NCCU MEASUREMENT REPORT
J. M. Dutta and C. R. Jones *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths

Oct. 1991 4 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

N92-25009 Nancy Univ. (France). Lab. Infrarouge.
UNIVERSITE DE NANCY (FRANCE) MEASUREMENT REPORT
A. Hadni and X. Gerbaux *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 7 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

N92-25010 Rockwell International Science Center, Thousand Oaks, CA.
ROCKWELL INTERNATIONAL MEASUREMENT REPORT
W. Hall and W. Ho *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 4 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

N92-25013 Georgia Tech Research Inst., Atlanta.
GEORGIA INSTITUTE OF TECHNOLOGY FABRY-PEROT MEASUREMENTS
In National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 14 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

N92-25089*# Lockheed Missiles and Space Co., Palo Alto, CA.
DEVELOPMENT OF A PRECISION, SIX-AXIS LABORATORY DYNAMOMETER
P. J. Champagne, S. A. Cordova, M. S. Jacoby, and K. R. Lorell *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 331-348 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 07D

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics*.

N92-24280# Lawrence Livermore National Lab., CA.
PHOTOPUMPING OF A SOFT X RAY LASER BY NARROW QUASI-CONTINUOUS BAND RADIATION
Yim T. Lee, J. K. Nash, and M. Finkenthal (Hebrew Univ., Jerusalem, Israel) 1991 10 p Presented at the Society of Photo-Optical Instrumentation Engineers Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-48)
(DE92-008564; UCRL-JC-105790; CONF-9107115-70) Avail: NTIS HC/MF A02

We propose a laser scheme in which the upper levels of a lasing ion are pumped by narrow, quasi-continuous band radiation. In particular, we consider pumping of neon-like chlorine ions by N band radiation of Pb from 41 to 44 A. We calculate small signal gain coefficients for the n = 4 - n = 3 transitions in neon-like chlorine. Both steady state and time dependent calculations have shown that the largest gain is found for the 2s(sup 2)2p(sub (1/2))(sup -1)4f(sub 5/2)(J = 2) - 2s2p (sub (1/2))(sup -1)3d(sub 3/2)(J = 1) transition at a wavelength of 264 A, with a value of 5 cm(exp -1). Achieving this value for the gain would require a pump radiation which has a brightness of 0.01 photons/mode, corresponding to an intensity of 1.6 x 10(exp 12) W/sq cm. DOE

N92-24299# Los Alamos National Lab., NM.
RADIOLOGICAL SHIELDING CALCULATIONS FOR AN AIRBORNE FREE-ELECTRON LASER
W. C. Sailor and J. W. Davidson 1991 6 p Presented at the Meeting on New Horizons in Radiation Protection and Shielding, Pasco, WA, 26 Apr. - 1 May 1992
(Contract W-7405-eng-36)
(DE92-004577; LA-UR-91-4141; CONF-920431-6) Avail: NTIS HC/MF A02

A preliminary set of Monte Carlo calculations of the crew exposure for the proposed airborne free-electron laser have resulted in a lead shielding mass of approximately 6 metric tons. The laser is to be operated only for four training missions per crew per year, with two minutes of laser operation per mission. Beam loss into the cavity walls, the main cause of the crew exposure, is to be kept below 0.01 percent. The crew will receive about 2.7 R per year, mostly from bremsstrahlung. Neutron dose rates will be negligible by comparison. DOE

N92-24570# State Univ. of New York, Buffalo. Advanced Microscopy and Imaging Lab.
SOFT X RAY MICRORADIOGRAPHY AND LITHOGRAPH USING A LASER PRODUCED PLASMA SOURCE
P. C. Cheng 1992 11 p
(Contract DE-FG03-89SF-18012)
(DE92-008471; DOE/SF-18012/T1) Avail: NTIS HC/MF A03

Considering the hardware characteristics of the laser-induced plasma x-ray source and the limitations of the conventional cone-beam reconstruction algorithm, a general cone-beam reconstruction algorithm has been developed at our laboratory. The motion locus of the x-ray source is an arbitrary curve corresponding to at least a 2(pi) continuous horizontal angular displacement in the coordinate system of the specimen. The preliminary simulation shows that the general cone-beam reconstruction algorithm consistently results in visually satisfactory images. DOE

N92-24576# Sandia National Labs., Albuquerque, NM.
TECHNIQUES AND APPLICATIONS OF LASER SPARK SPECTROSCOPY
R. W. Schmieder Feb. 1992 25 p Presented at the International Conference on Lasers, New Orleans, LA, 13-17 Dec. 1982
(Contract DE-AC04-76DR-00789)
(DE92-008635; SAND-83-8618; CONF-821203-8) Avail: NTIS HC/MF A03

Laser breakdown provides a simple technique for producing a small, hot plasma of practical value as an analytic spectroscopic source. The principal features of this source are its small size, short duration, and high brightness. These features combine to make it useful as an analytical probe in unfavorable environments such as high temperature, inhomogeneous, unsteady, chemically reactions gases. A review is given here of various laboratory techniques for initiating and controlling the development of the spark, of procedures for analyzing the emission and interpreting spatially resolved images, and of some recent applications. DOE

N92-24673# Utah Univ., Salt Lake City.
PULSED LASER KINETIC STUDIES OF LIQUIDS UNDER HIGH PRESSURE
E. M. Eyring 25 Nov. 1991 4 p
(Contract DE-FG02-84ER-13227)
(DE92-008085; DOE/ER-13227/T3) Avail: NTIS HC/MF A01

A high pressure apparatus constructed for measuring the rates of reactions in liquids under pressures ranging from 1 to 2000 atm has been used to measure the complexation kinetics of molybdenum hexacarbonyl reacting with 2,2-bipyridine, 4,4'-dimethyl 2-2'-bipyridine and 4,4'-diphenyl 2-2'-bipyridine in toluene. Pentacarbonyl reaction intermediates are created by a 10 nsec flash of frequency tripled Nd:YAG laser light. Measured activation volumes for chelate ligand ring closure indicate a change in mechanism from associative interchange to dissociative interchange as steric hindrance increases. A similar high pressure kinetics study of molybdenum carbonyl complexation by several

substituted phenanthrolines is now well advanced that indicates that with the more rigid phenanthroline ligands steric effects from bulky substituents have less effect on the ring closure mechanism than in the case of the bipyridine ligands. An experimental concentration dependence of the fluorescence quantum yield of cresyl violet has been harmonized with previously published contradictory reports. Fluorescence of cresyl violet in various solvents and in micellar systems has also been systematically explored. DOE

N92-24710# Lawrence Livermore National Lab., CA.
FURTHER ADVANCES IN GAS IMAGING: FIELD TESTING OF AN EXTENDED-RANGE GAS IMAGER
T. J. Kulp, R. Kennedy, D. Garvis, L. Seppala, D. Adomatis, and J. Stahovec (Naval Sea Systems Command, Washington, DC.) Oct. 1991 11 p Presented at the International Conference on Lasers 1990, San Diego, CA, 3-7 Dec. 1990
(Contract W-7405-eng-48)
(DE92-008922; UCRL-JC-106912; CONF-901293-3) Avail: NTIS HC/MF A03

Backscatter absorption gas imaging (BAGI) is a laser gas-sensing technique that allows the real-time video imaging of gas plumes. It is essentially a hybrid between lidar and laser radar (ladar), in that it uses a laser active-imager to produce laser-illuminated video image of specific locations and the absorptive properties of gases to allow gas leaks to be detected and located. This paper presents the results of a test of an extended-range BAGI instrument that uses a 20-W CO2 laser. As a result of the test, the imager was determined to have a range of 125 m. The range results are compared to the predictions of a basic system performance model. The model is also used to predict the performance of a future imaging system that utilizes a 5X telescope to increase the system optical collection efficiency. DOE

N92-25107# Lawrence Livermore National Lab., CA.
SPATIAL COHERENCE DIAGNOSTIC FOR X RAY LASERS
J. E. Trebes, S. Mrowka, R. A. London, T. W. Barbee, M. R. Carter, B. J. MacGowan, D. L. Matthews, L. B. DaSilva, G. F. Stone, and M. D. Feit et al Sep. 1991 12 p Presented at the Society of Photo-Optical Instrumentation Engineers Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-48)
(DE92-008610; UCRL-JC-108449; CONF-9107115-72) Avail: NTIS HC/MF A03

The spatial coherence of a neon-like selenium x ray laser operating at 206 and 210 A has been measured using a technique based on partially coherent x ray diffraction. The time integrated spatial coherence of the selenium x ray laser was determined to be equivalent to that of a quasi-monochromatic spatially incoherent disk source whose diameter is comparable to the line focus of the visible light laser pumping the x ray laser. The spatial coherence was improved by narrowing the line focus width. DOE

N92-25120# Lawrence Livermore National Lab., CA.
LASER-INDUCED DAMAGE THRESHOLD COMPARISON OF REACTIVE LOW VOLTAGE ION PLATED AND E-BEAM COATINGS
R. Chow, C. J. Stolz, F. Rainer, G. E. Loomis, K. H. Guenther, K. Balasubramamian, and X. Q. Hu Oct. 1991 14 p Presented at the SPIE International Society for Optical Engineering Meeting, Boulder, CO, 23-25 Oct. 1991
(Contract W-7405-eng-48)
(DE92-008561; UCRL-JC-108716; CONF-911064-8) Avail: NTIS HC/MF A03

Single layer coatings of hafnia are included with results obtained with titania, tantala, zirconia and silica. These coatings were deposited by a reactive low voltage ion plating (RLVIP) and conventional reactive e-beam process. Layer thicknesses were optically a lambda/4 at 532 nm. The RMS surface roughness changes between the uncoated and coated were on the sub-angstrom level. The spectral transmittance curves demonstrated the material thickness homogeneity aspect of the RLVIP process. Laser damage thresholds were made from high peak power (1.06 and 0.532 micron, 10 ns) and high average power (511 and 578 nm) laser damage test facilities. Given a set of coatings from one process, the damage thresholds tended to increase as the refractive index decreased. The e-beam silica coating had the highest damage threshold, exceeding 98 J/sq cm (1.06 micron 10 ns, 10 Hz). In addition, the surface absorption and refractive indices of the coatings were measured, and the X ray diffraction patterns of the hafnia coatings made. DOE

N92-25122# Lawrence Livermore National Lab., CA.
THE INTENSE MICROWAVE PROTOTYPE (IMP) FREE ELECTRON LASER, 140 GIGAHERTZ MICROWAVE SYSTEM FOR THE MICROWAVE TOKAMAK EXPERIMENT (MTX)
B. Felker and S. W. Ferguson Sep. 1991 8 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract W-7405-eng-48)
(DE92-008596; UCRL-JC-107243; CONF-910968-72) Avail: NTIS HC/MF A02

This paper will present the design, construction, and magnetic test results of the Intense Microwave Prototype (IMP) Free Electron Laser and all of the Microwave System special hardware developed for operation as a plasma heating source for the Microwave Tokamak Experiment. The test results presented will not include electron beam data for the FEL. Those tests will begin in November 1991. The master oscillator for the FEL is a 140 GHz, 400 kW gyrotron. Microwave power will be transmitted to the entrance to the wiggler by waveguide, miter bends, a waveguide-to-free-space vlasov mode convertor, and aluminum quasi-optical mirrors. The electron beam of approx. 2.5 k amps up to 7.5 MeV, and greater than 10(exp 8) A/ sq m-rad brightness will be introduced colinear with the microwave beam into the FEL. The IMP FEL is tunable and made up to both permanent and electromagnets. It is 5.5 meters long with a 10 cm period between shaped steel pole tips. The electromagnets are water cooled, carry up to 140 amps continuously and can be adjusted to vary the wiggler fields from 600 to 5500 gauss. The spent electron beam will be dumped into a water cooled, lead shielded carbon dump. The microwave pulses, at up to 5 GW power levels, will be transmitted through a series of mirrors to the Microwave Tokamak Experiment. Another swinging mirror will reflect the microwave power into a microwave dump/calorimeter for accelerator and FEL conditioning. DOE

N92-24770# Harbin Inst. of Tech. (China). Dept. of Applied Physics.
THE LASER SENSOR FOR RENDEZVOUS AND DOCKING OF SPACECRAFT
Yong-Jiang Dai, Yuan Zhao, Xi-Ping Cai, Tai-Ling Xin, and Chun-Fei Li *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 373-375 (For primary document see N92-24719 15-12)
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37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N92-24202*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A BASIS FOR SOLID MODELING OF GEAR TEETH WITH APPLICATION IN DESIGN AND MANUFACTURE
Ronald L. Huston, Dimitrios Mavriplis, Fred B. Oswald, and Yung Sheng Liu (Cincinnati Univ., OH.) Apr. 1992 17 p
(Grant NsG-3188; DA Proj. 1L1-62211-A-47-A)
(NASA-TM-105392; E-6782; NAS 1.15:105392;
AVSCOM-TR-91-C-044) Avail: NTIS HC/MF A03 CSCL 13K

A new approach to modeling gear tooth surfaces is discussed. A computer graphics solid modeling procedure is used to simulate the tooth fabrication process. This procedure is based on the principles of differential geometry that pertain to envelopes of

curves and surfaces. The procedure is illustrated with the modeling of spur, helical, bevel, spiral bevel, and hypoid gear teeth. Applications in design and manufacturing are discussed. Extensions to nonstandard tooth forms, to cams, and to rolling element bearings are proposed. Author

N92-24243*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DOUBLE-V BLOCK FINGERS WITH CRUCIFORM RECESS Patent Application
George M. Voellmer, inventor (to NASA) 16 Sep. 1991 22 p (NASA-Case-GSC-13356-1; NAS 1.71:GSC-13356-1; US-Patent-Appl-SN-760634) Avail: NTIS HC/MF A03 CSCL 13K

In a robot having a gripper including a pair of fingers and a drive motor for driving the fingers toward and away from one another while the fingers remain parallel to each other, the fingers consist of finger pads, which interface with a handle on an object to be grasped, and a shank, which attaches the fingers to the robot gripper. The double V finger has two orthogonal V grooves forming in the center of the finger pads and a recessed cruciform. The double V finger is used with a handle on the object to be grasped which is the negative of the finger pads. The handle face consists of V shaped pads capped with a rectangular cruciform. As the gripper is brought into place near the handle, the finger pads are lined up facing the handle pads. When the finger pads and the handle are in proper alignment, the rectangular ridges on the handle fall inside the rectangular grooves on the finger, and the grip is complete. NASA

N92-24984*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ADVANCED ROTORCRAFT TRANSMISSION (ART) PROGRAM SUMMARY
T. L. Krantz and J. G. Kish (Sikorsky Aircraft, Stratford, CT.) 1992 14 p Presented at the 28th Joint Propulsion Conference, Nashville, TN, 6-8 Jul. 1992; sponsored in part by AIAA, SAE, ASME, and ASEE
(DA Proj. 1L1-62211-A-47-A)
(NASA-TM-105665; E-7027; AVSCOM-TR-92-C-011; NAS 1.15:105665; AIAA-92-3365) Avail: NTIS HC/MF A03 CSCL 13I

The Advanced Rotorcraft Transmission (ART) Program was initiated to advance the state of the art for rotorcraft transmissions. The goal of the ART Program was to develop and demonstrate the technologies needed to reduce transmission weight by 25 pct. and reduce noise by 10 dB while obtaining a 5000 hr 'mean time between failure'. The research done under the ART Program is summarized. A split path design was selected as best able to meet the program goals. Key part technologies needed for this design were identified, studied, and developed. Two of these technologies are discussed in detail: the load sharing of split path designs including the use of a compliant elastomeric torque splitter and the application of a high ratio, low pitch line velocity gear mesh. Development of an angular contact spherical roller bearing, transmission error analysis, and fretting fatigue testing are discussed. The technologies for a light weight, quiet, and reliable rotorcraft transmission were demonstrated. Author

N92-25022# National Inst. of Standards and Technology, Gaithersburg, MD.
PERFORMANCE EVALUATION OF A VARIABLE SPEED, MIXED REFRIGERANT HEAT PUMP
P. I. Rothfleisch and D. A. Didion Jun. 1991 59 p Sponsored by Environmental Protection Agency, Research Triangle Park, NC (PB92-143759; NISTIR-4597) Avail: NTIS HC/MF A04 CSCL 13K

The performance of an innovative heat pump, equipped with a distillation column to shift the composition of a zeotropic refrigerant mixture, was evaluated. The results of the DoE rating tests and seasonal energy calculations are reported with the main cycle refrigerant compositions. No composition shifting of the circulating refrigerant mixture was observed. To demonstrate the potential value of composition shifting, an ideal vapor compression cycle computer program was used to predict the system performance had composition shifting occurred. Seasonal energy usage calculations based on the computer predictions demonstrated that the effect of composition shifting on High Seasonal Performance Factor (HSPF) was very small, increasing slightly with climate zone. However, the savings in auxiliary heat was found to be substantial. In cooling mode, computer predictions showed pure R22 to have a cooling energy efficiency (SEER) approximately two percent higher than a mixture of 20 percent R13B1 and 80 percent R22 by weight. GRA

N92-25044# Oak Ridge National Lab., TN.
THICK-SECTION WELDMENTS IN 21-6-9 AND 316LN STAINLESS STEEL FOR FUSION ENERGY APPLICATIONS
D. J. Alexander and G. M. Goodwin 1991 13 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract DE-AC05-84OR-21400)
(DE92-008260; CONF-911111-36) Avail: NTIS HC/MF A03

The mechanical properties of several weldments in 21-6-9 and 316LN stainless steel metals have been measured at 77 K and room temperature. Filler metals for the 21-6-9 included Nitronic 35W and 40W; 21-6-9; Inconel 82, 182, 625, and 625 PLUS. For the 316LN base metal, 316L, 316L-T3, 316L-4K-O, and Inconel 82, filler metals were used. At room temperature, all of the filler metals had yield strengths that exceeded those of the base metals. At 77 K, only the Nitronics and the 21-6-9 filler metals exceeded those of the base metals, and the Inconel filler metals were significantly weaker. The impact properties of the weld metals were very good at room temperature, with the exception of Inconel 625. At 77 K, the impact toughness was greatly reduced for all of the filler metals, with the dramatic exception of Inconel 82. The 316L-4K-O filler metal showed higher impact energies than the other ferrite-containing filler metals, although the levels were still much lower than for the Inconel filler metals. The Inconel 82 filler had excellent fracture toughness at both temperatures. DOE

N92-25054# Kumm (Emerson L.), Tempe, AZ.
FLAT BELT CONTINUOUSLY VARIABLE HIGH SPEED DRIVE
Emerson L. Kumm Feb. 1992 53 p
(Contract DE-FG01-90CE-15470)
(DE92-008952; DOE/CE-15470/T7) Avail: NTIS HC/MF A04

A study was undertaken at Kumm Industries funded by DOE in the NBS/DOE Energy-Related Inventions Program starting in August 1990 to design, construct and test a novel very high speed flat belt drive. The test arrangement consists of a multiple belt-pulley configuration that transmits power from a low speed (2000-4000 RPM) input to a small pulley 'turbine' (27,000 to 55,000 RPM) and then to the low speed output variable radius pulley (2000-5000 RPM) via a special self-active tensioner. Transmitting 25 HP to and from the 'turbine' corresponds to obtaining 50 HP in one direction only in a possible turbo compounded engine application. The high speed of the 'turbine' belts, i.e. 100 meters/sec at 55,000 RPM, while transferring substantial power is a new much higher operating regime for belts. The study showed that the available belts gave overall test rig efficiencies somewhat above 80 percent for the higher speeds (50,000 RPM) and higher powers (corresponding to above 90 percent in the turbocompound application) and significantly better efficiencies at slightly lower speeds. The tests revealed a number of improved approaches in the design of such high speed drives. It appears that there is considerable possibility for further improvement and application of such equipment. DOE

N92-25101# New Energy Development Organization, Tokyo (Japan).
SURVEY ON THE ENERGY TRANSPORTATION TECHNOLOGY FOR THE ALTERNATIVE ENERGIES
Mar. 1991 299 p In JAPANESE; ENGLISH summary
(DE92-769382; NEDO-P-9006) Avail: NTIS HC/MF A13

A system is studied in which hydrogen is produced through a water electrolysis process using clean energy from hydro-electric

and solar power generators which can be obtained overseas with relative ease and at a low cost and is converted to a transportable chemical medium for transportation to Japan and utilization as energy like electricity, etc. The hydroelectric power generation is the most realistic alternative energy source in terms of energy density, technology and economy. The feasibility is described the development of hydroelectric power generation using rivers in Indonesia and Canada. As chemical substances which can be transportable chemical media, methanol/CO cycle (methanol is synthesized from coal gasified CO and electrolytic hydrogen) or liquid hydrogen cycle are the most practical on a short-term basis, and ammonia cycle and cyclohexane cycle are more advantageous than other cycles on a long-term basis. It is essential to reduce a cost of water electrolysis for each chemical substance. Potential needs are great for distribution and utilization of hydrogen energy regenerated from the transportable chemical medium, but it requires a lot of technological innovations regarding the system structure and materials (safety, particularly). DOE

N92-25105# Los Alamos National Lab., NM.
SPATIAL INTENSITY PROFILING OF AN INDUSTRIAL LASER WELDING SYSTEM
J. O. Milewski 1991 9 p Presented at the International Conference on Lasers 1991, San Diego, CA, Dec. 1991
(Contract W-7405-eng-36)
(DE92-007590; LA-UR-92-323; CONF-911296-2) Avail: NTIS HC/MF A02

A investigation was conducted to devise a method to sense the laser beam intensity profile of an industrial laser welding system. The research focuses on monitoring methods and assessing locations within the system where data can be taken which reveal the relationship between the laser beam intensity profile and the input system parameters of the laser beam welding process. Emphasis has been placed on the configuration of a distributed computing environment to acquire, analyze, and display the results of the sensed beam profile. Conventional image processing techniques are demonstrated. It was found that a distributed computing environment was useful for processing the large volumes of data generated by this process characterization method, and the distributed computing environment provided the computing power required for computationally intensive analysis and display techniques. The mathematical techniques used to discriminate one data set from another and relate the results to processing conditions are discussed. DOE

N92-24318*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Ground Antennas and Facilities Engineering Section.
DYNAMIC MODELING OF THE SERVOVALVES INCORPORATED IN THE SERVO HYDRAULIC SYSTEM OF THE 70-METER DSN ANTENNAS
R. D. Bartos *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 222-234 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 13I

N92-24380# Dortmund Univ. (Germany, F.R.). Inst. fuer Roboterforschung.
THE INSTITUTE FOR ROBOTICS (IRF) [IRF: INSTITUT FUER ROBOTERFORSCHUNG]
E. Freund *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 77-79 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24381# Dortmund Univ. (Germany, F.R.). Inst. fuer Roboterforschung.
CONTROL OF MODULAR AUTOMATION OF ROBOTICS SYSTEM (MARS) [MARS-STEUERUNG: MODULARES AUTOMATION UND ROBOTIK SYSTEM TESTBED]
E. Freund *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 81-82 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24382# Gesamthochschule, Paderborn (Germany, F.R.). Fachbereich Automatisierungstechnik.
DEVELOPMENT OF THE LINKAGE CONTROLLER FOR THE ROTEX ROBOT [ROTEX: ENTWICKLUNG DER GELENKREGLER FUER DEN ROTEX-ROBOTER]
W. Moritz and R. Neumann *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 83-84 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24383# Gesamthochschule, Paderborn (Germany, F.R.). Inst. fuer Automatisierungstechnik.
DEVELOPMENT OF CARBON FIBER REINFORCED PLASTICS ROBOTS [ENTWICKLUNG VON CFK-ROBOTERN]
M. Stark, M. Stoeger (Technische Hochschule, Aachen, Germany, F.R.), and W. Moritz *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation in Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 85-86 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24384# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Leichtbau.
STRUCTURAL MECHANICS INVESTIGATIONS FOR THE TELMAN TELESCOPE MANIPULATOR ARM [STRUKTURMECHANISCHE UNTERSUCHUNGEN FUER DEN TELESKOPMANIPULATORARM TELMAN]
S. Zurhorst and A. Rittweger *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 87-88 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-25068*# TiNi Alloy Co., Oakland, CA.
DEVELOPMENT OF A NON-EXPLOSIVE RELEASE DEVICE FOR AEROSPACE APPLICATIONS
John D. Busch, William E. Purdy (Naval Research Lab., Washington, DC.), and A. David Johnson *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 1-16 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25069*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
NOVEL AEROSPACE MECHANISMS: A PASSIVE TETHER DAMPING DEVICE FOR TETHERED SATELLITE, AND A PIN/LATCH STRUCTURAL INTERFACE SYSTEM
John W. Redmon, Jr. *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 17-32 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25070*# Aerospatiale, Cannes (France). Space and Strategic Systems Div.
DEPLOYMENT HINGE USING WRAPAROUND STRIPS [ADELE: ARTICULATION DE DEPLOIEMENT A LAMES D'ENROULEMENT]
Eric Blanc *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 33-44 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25071*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DEPLOYMENT AND RETRIEVAL MECHANISM REDESIGNED FOR SPARTAN SPACECRAFT ON THE STS
Greg Galloway *In its* The 26th Aerospace Mechanisms Symposium May 1992 p 45-60 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25072*# Maryland Univ., College Park. Space Systems Lab.
MANIPULATOR DESIGN AND DEVELOPMENT FOR THE RANGER SATELLITE SERVICING VEHICLE
Russell D. Howard and David L. Akin *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 61-74 (For primary document see N92-25067 15-39) (Grant NAGw-2245)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25073*# Dornier-Werke G.m.b.H., Friedrichshafen (Germany, F.R.).
EXPERIENCES IN THE DEVELOPMENT OF ROTARY JOINTS FOR ROBOTIC MANIPULATORS IN SPACE APPLICATIONS
Klaus Priesett *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 75-89 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25074*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SPLINE-LOCKING SCREW FASTENING STRATEGY
John M. Vranish *In its* The 26th Aerospace Mechanisms Symposium May 1992 p 91-110 Previously announced as N92-22690 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25075*# Honeywell, Inc., Glendale, AZ. Satellite System Operation.
MODULAR ANTENNA POINTING SYSTEM FOR THE EXPLORER PLATFORM SATELLITE
James Andrus and Ed Korzeniowski *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 111-126 Sponsored in part by Fairchild Space Co. (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25076*# Aerospatiale, Cannes (France). Space and Strategic Systems Div.
WEARING OF CRYOMECHANISMS AT 4 K
Gerard Luciano *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 127-137 Previously announced as N90-24139 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25077*# AEC-Able Engineering Co., Inc., Goleta, CA.
INVACUO TRIBOLOGICAL EVALUATION OF COARSE-PITCH GEARS FOR USE ON THE SPACE STATION ALPHA JOINT
Scotty R. Allen *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 139-155 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25080*# Ball Aerospace Systems Div., Boulder, CO. Electro-Optics/Cryogenics Div.
SOHO MAMA OPENABLE COVER/VACUUM SEAL MECHANISM
Mitchell T. Wiens *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 189-203 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25081*# Ball Aerospace Systems Div., Boulder, CO.
ARM DEPLOY MECHANISMS TO HELP CORRECT THE HUBBLE SPACE TELESCOPE'S VISION
F. Kent Copeland and Randall R. Whitaker *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 205-220 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25082*# Starsys Research Corp., Boulder, CO.
DEVELOPMENT OF A RESETTABLE, FLEXIBLE APERTURE COVER
Scott Christiansen *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 221-234 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25083*# Lockheed Missiles and Space Co., Sunnyvale, CA.
MILSTAR'S FLEXIBLE-SUBSTRATE SOLAR ARRAY: LESSONS LEARNED
John Gibb *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 235-243 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25085*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A 23.2:1 RATIO, 300-WATT, 26 N-m OUTPUT TORQUE, PLANETARY ROLLER-GEAR ROBOTIC TRANSMISSION: DESIGN AND EVALUATION
Wyatt S. Newman, William J. Anderson, William Shipitalo (NASTEC, Inc., Cleveland, OH.), and Douglas Rohn *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 263-279 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

N92-25088*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DESIGN, DEVELOPMENT, AND FABRICATION OF EXTRAVEHICULAR ACTIVITY TOOLS FOR THE TRANSFER ORBIT STAGE
L. M. Albritton, J. W. Redmon, and T. R. Tyler *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 315-329 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N92-24274# International Atomic Energy Agency, Vienna (Austria).
TRAINING GUIDELINES IN NON-DESTRUCTIVE TESTING TECHNIQUES, 1991 EDITION
Oct. 1991 274 p
(DE92-615082; IAEA-TECDOC-628) Avail: NTIS HC/MF A12

Nondestructive testing methods (NDT), by their very nature, allow components to be fully examined for properties or flaws without interfering with their usefulness. This grouping of inspection methods has grown from a handful of primitive techniques practiced by artists to a widely known discipline which is an essential part of quality control, largely as a result of the standards demanded by the nuclear and aerospace industries. Recognizing the need for an international publication of NDT training syllabi, the IAEA Consultants Meeting on 'Qualification and Certification of NDT Personnel' (Milan, 20-21 May 1986), recommended that the Agency publish the guidelines developed by Regional Working Group of

the Latin America and Caribbean project. It was first issued in English in 1987 and has now been re-edited in English and Spanish and enlarged by the addition of program for other techniques. DOE

N92-24890*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
NASA TOTAL QUALITY MANAGEMENT 1989 ACCOMPLISHMENTS REPORT
Jun. 1990 116 p
(NASA-TM-107848; NAS 1.15:107848; PB92-163138) Avail: NTIS HC/MF A06 CSCL 14D

Described here are the accomplishments of NASA as a result of the use of Total Quality Management (TQM). The principles in practice which led to these process refinements are important cultural elements to any organization's productivity and quality efforts. The categories of TQM discussed here are top management leadership and support, strategic planning, focus on the customer, employee training and recognition, employee empowerment and teamwork, measurement and analysis, and quality assurance. Author

N92-24900*# National Aeronautics and Space Administration, Washington, DC.
GOVERNMENT QUALITY CONFERENCE PROCEEDINGS
1992 70 p Conference held in Washington, DC, 29 Oct. 1985
(NASA-TM-107841; NAS 1.15:107841; PB92-162825) Avail: NTIS HC/MF A04 CSCL 14D

The Government Quality Conference was an attempt to bring together executive organizations and senior individuals in the Federal Government that have a desire to improve productivity. It was designed to provide an exchange of ideas based on experience, and to encourage individual management initiatives to tap the capabilities of Federal employees. Author

N92-24986*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
TENSILE STRAIN MEASUREMENTS OF CERAMIC FIBERS USING SCANNING LASER ACOUSTIC MICROSCOPY
Renee M. Kent (Dayton Univ., OH.) and Alex Vary 1992 8 p Presented at the 16th Annual Conference on Composites and Advanced Ceramics, Cocoa Beach, FL, 7-10 Jan. 1992; sponsored in part by American Ceramic Society
(NASA-TM-105589; E-6919; NAS 1.15:105589) Avail: NTIS HC/MF A02 CSCL 14D

A noncontacting technique using scanning laser acoustic microscopy for making in situ tensile strain measurements of small diameter fibers was implemented for the tensile strain analysis of individual Nicalon SiC fibers (nominal diameter 15 microns). Stress versus strain curves for the fibers were plotted from the experimental data. The mean elastic modulus of the fibers was determined to be 185.3 GPa. Similar measurements were made for Carborundum SiC fibers (nominal diameter 28 microns) and Saphikon sapphire fibers (nominal diameter 140 microns), yielding and elastic modulus of 401 and 466.8 GPa, respectively. Author

N92-25065# Oak Ridge Y-12 Plant, TN.
A VISUAL INSPECTION SYSTEM FOR EVALUATING THE INTERIOR SURFACE FINISH OF VALVE FLANGES ON HAZARDOUS MATERIAL STORAGE CONTAINERS
C. A. Pickett Aug. 1991 7 p Presented at the Review of Progress in Quantitative Nondestructive Evaluation (NDE), Brunswick, ME, 28 Jul. - 2 Aug. 1991
(Contract DE-AC05-84OS-21400)
(DE92-008032; Y/DW-1088; CONF-9107112-8) Avail: NTIS HC/MF A02

Hazardous material storage containers are used at the Oak Ridge Y-12 Plant for safely storing and/or transporting hazardous material products. A picture is given of the complete hazardous material storage container system. Because of the adverse consequences associated with one of these containers leaking or releasing some or all of its contents into the environment, it is very important that methods exist for verifying the quality and integrity of each hazardous material storage container. Nondestructive tests that are conducted prior to and during the assembly process, serve to certify the quality and functionality of each container. As in many new operations, the appropriate equipment or methods do not always exist to implement the mandatory (nondestructive) evaluation(s), and development work is required. In this case, an informal request was made to devise a nondestructive method (either quantitative or qualitative) that could quickly verify whether or not the interior surface finish of the valve flange on hazardous material container tops was adequate. As a result of the advances in fiberoptic technology, a fiberoptic borescope inspection system can now be used to inspect parts or areas of parts that were, just a few years ago, considered un-inspectable. A fiberoptic borescope system can also be used to complement mechanical inspection equipment that has trouble extending into deep narrow orifices, such as the hazardous material container top's valve flange. A fiberoptic borescope system produces reliable qualitative results, which, if necessary, can be quantified by using an intelligent image processing system. The number of NDE applications for fiberoptic inspection systems will continue to grow, as the technology continues to mature. DOE

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N92-24199# National Aeronautical Lab., Bangalore (India). Structural Sciences Div.
ESTIMATION TECHNIQUES OF RANDOM VIBRATION LEVELS FOR MISSILE STRUCTURES: A CRITICAL EVALUATION
G. Chandrasekharappa and R. Balasubramaniam Apr. 1991 44 p
(NAL-TM-ST-9101) Avail: NTIS HC/MF A03

Vibration environment estimation and prediction is required for the aerospace vehicle during the initial phase of an aerospace equipment program in order to support design and procurement specifications. For many aerospace systems, acoustically driven random vibration represents the most significant vibration environment. Numerous procedures have been developed by individuals in the vibration field. A brief review of the estimation and prediction techniques developed in the past few decades for random vibration levels have been presented in this report focusing attention on aerospace vehicles and in particular on missile structures. Author

N92-24205*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
THERMAL AND STRUCTURAL TESTS OF RENE 41 HONEYCOMB INTEGRAL-TANK CONCEPT FOR FUTURE SPACE TRANSPORTATION SYSTEMS
John L. Shideler, Roger A. Fields, Lawrence F. Reardon, and Leslie Gong (National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Facility, Edwards, CA.) May 1992 77 p
(NASA-TP-3145; L-16752; NAS 1.60:3145) Avail: NTIS HC/MF A05 CSCL 20L

Two flat 12 by 72 inch Rene 41 honeycomb sandwich panels were tested in a manner to produce combined thermal and mechanical longitudinal stresses that simulated those that would occur in a larger, more complex integral tank and fuselage structure of an earth to orbit vehicle. Elastic strains measured at temperatures below 400 F are compared with calculated values obtained from a linear elastic finite element analysis to verify the analytical model and to establish confidence in the calculated strains. Elastic strain measurement at higher temperatures (between 600 F and 1400 F), where strain measurement is more difficult and less certain, are also compared with calculated strains. Agreement between measured and calculated strains for the lower

temperatures is good, but agreement for the higher temperatures is poor because of unreliable strain measurements. Test results indicate that an ascent and entry life cycle of 500 is attainable under high combined thermal and mechanical elastic strains.
Author

N92-24207*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
ESTIMATION OF KALMAN FILTER GAIN FROM OUTPUT RESIDUALS
Jer-Nan Juang, Chung-Wen Chen, and Minh Phan (Lockheed Engineering and Sciences Co., Hampton, VA.) Apr. 1992 15 p (NASA-TM-107603; NAS 1.15:107603) Avail: NTIS HC/MF A03 CSCL 20K

This paper presents a procedure for estimating the Kalman filter gain from output residuals. The system state space model is assumed to be known, but the process and noise covariance are unknown. The proposed procedure consists of three basic steps. First, the output residuals are computed from the given model and a given set of input-output data. Second, a linear regression model for this part of the response is computed by a least squares solution. Third, the Kalman filter gain is then estimated from the coefficients of this model. Numerical results using experimental data are presented to illustrate the validity of the developed procedure.
Author

N92-24230 Materials Research Labs., Ascot Vale (Australia).
THE INFLUENCE OF GRAIN BOUNDARY FRACTURE ON FRAGMENTATION BEHAVIOUR, PART 2
George M. Weston and Norbert M. Burman Oct. 1991 17 p (MRL-TR-91-36) Copyright Avail: Issuing Activity

The effect of grain boundary sulfide precipitation on fragmentation performance has been investigated for low alloy steel cylinders tempered at selected temperatures within the range of 150 C to 550 C. It was found that increased cylinder hardness generally increased the fineness of the cylinder fragmentation for both specially heat treated cylinders with sulphide precipitates present at grain boundaries, as well as standard untreated specimens. Over the range of tempering temperatures used, the specially treated cylinders showed generally finer fragmentation as measured by a 15 to 30 percent increase in the length normalized Payman fragmentation parameter measured for these cylinders. Both fractographic and metallographic evidence indicated that the presence of grain boundary sulfide precipitation assisted in cylinder breakup for steel of the type tested.
Author

N92-24232 Materials Research Labs., Ascot Vale (Australia).
CALCULATION OF THE ENERGY OF ELASTIC DEFORMATION OF KEVLAR BACKING PLATES FOR CERAMIC ARMOURS
R. G. ODonnell Jan. 1992 17 p
(MRL-TN-596) Copyright Avail: Issuing Activity

An equation is developed which enables calculation of the elastic deformation energy of a Kevlar plate used as a backing for ceramic armor, following projectile impact. Knowledge of the plate profile at maximum deflection is required. Plate profiles were obtained by photographically recording ballistic impacts. The energy of deformation of the composite backing represents 30 to 36 percent of the projectile's initial kinetic energy as calculated for two lightweight ceramic armors.
Author

N92-24235*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SYSTEM IDENTIFICATION FROM CLOSED-LOOP DATA WITH KNOWN OUTPUT FEEDBACK DYNAMICS
Minh Phan, Jer-Nan Juang, Lucas G. Horta, and Richard W. Longman (Columbia Univ., New York, NY.) Apr. 1992 34 p (NASA-TM-107604; NAS 1.15:107604) Avail: NTIS HC/MF A03 CSCL 20K

This paper presents a procedure to identify the open loop systems when it is operating under closed loop conditions. First, closed loop excitation data are used to compute the system open loop and closed loop Markov parameters. The Markov parameters, which are the pulse response samples, are then used to compute a state space representation of the open loop system. Two closed loop configurations are considered in this paper. The closed loop system can have either a linear output feedback controller or a dynamic output feedback controller. Numerical examples are provided to illustrate the proposed closed loop identification method.
Author

N92-24324*# Computer Software Management and Information Center, Athens, GA.
TWENTIETH NASTRAN (R) USERS' COLLOQUIUM
Washington NASA Apr. 1992 188 p Colloquium held in Colorado Springs, CO, 27 Apr. - 1 May 1992 Sponsored by NASA, Washington
(NASA-CP-3145; NAS 1.55:3145) Avail: NTIS HC/MF A09 CSCL 20K

The proceedings of the conference are presented. Some comprehensive general papers are presented on applications of finite elements in engineering, comparisons with other approaches, unique applications, pre and post processing with other auxiliary programs, and new methods of analysis with NASTRAN. For individual titles, see N92-24325 through N92-24335.

N92-24325*# Unisys Corp., Huntsville, AL. NASA Structural Analysis Maintenance Group.
NASTRAN INTERNAL IMPROVEMENTS FOR 1992 RELEASE **c61**
Gordon C. Chan *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 1-8 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 09B

The 1992 NASTRAN release incorporates a number of improvements transparent to users. The NASTRAN executable was made smaller by 70 pct. for the RISC base Unix machines by linking NASTRAN into a single program, freeing some 33 megabytes of system disc space that can be used by NASTRAN for solving larger problems. Some basic matrix operations, such as forward-backward substitution (FBS), multiply-add (MPYAD), matrix transpose, and fast eigensolution extraction routine (FEER), have been made more efficient by including new methods, new logic, new I/O techniques, and, in some cases, new subroutines. Some of the improvements provide ground work ready for system vectorization. These are finite element basic operations, and are used repeatedly in a finite element program such as NASTRAN. Any improvements on these basic operations can be translated into substantial cost and cpu time savings. NASTRAN is also discussed in various computer platforms.
Author

N92-24326*# Rockwell International Corp., Downey, CA.
EVOLUTION OF A NASTRAN TRAINER **c61**
H. R. Grooms, P. J. Hinz, and M. A. Collier *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 9-22 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 09B

The development is traced of a NASTRAN training system. The design and organization of the program is examined, including the static and dynamic modules. A discussion of how user feedback, in the form of questionnaire responses, was used to evaluate and improve the trainer is included. The trainer was used by a number of engineers, who found it to be a versatile low cost tool. It is particularly helpful in bridging the gap from theory to practical application of the finite element method for structural analysis. The program, along with documentation, is available through COSMIC.
Author

N92-24327*# David Taylor Research Center, Bethesda, MD. Computational Signatures and Structures Branch.
ANIMATION OF FINITE ELEMENT MODELS AND RESULTS **c61**
Robert R. Lipman *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium

Apr. 1992 p 23-25 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 09B

This is not intended as a complete review of computer hardware and software that can be used for animation of finite element models and results, but is instead a demonstration of the benefits of visualization using selected hardware and software. The role of raw computational power, graphics speed, and the use of videotape are discussed. Author

N92-24328*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ACCURACY OF THE TRIA3 THICK SHELL ELEMENT
William R. Case, Marco Concha, and Mark McGinnis *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 26-50 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 20K

The accuracy of the new TRIA3 thick shell element is assessed via comparison with a theoretical solution for thick homogeneous and honeycomb flat simply supported plates under the action of a uniform pressure load. The theoretical thick plate solution is based on the theory developed by Reissner and includes the effects of transverse shear flexibility which are not included in the thin plate solutions based on Kirchoff plate theory. In addition, the TRIA3 is assessed using a set of finite element test problems developed by the MacNeal-Schwendler Corp. (MSC). Comparison of the COSMIC TRIA3 element as well as those from MSC and Universal Analytics Inc. (UAI) for these problems is presented. The current COSMIC TRIA3 element is shown to have excellent comparison with both the theoretical solutions and also those from the two commercial versions of NASTRAN with which it is compared. Author

N92-24329*# Naval Surface Warfare Center, Bethesda, MD. Ship Structures and Protection Dept.
VALIDATION OF THE CQUAD4 ELEMENT FOR VIBRATION AND SHOCK ANALYSIS OF THIN LAMINATED COMPOSITE PLATE STRUCTURE
Douglas E. Lesar *In* Computer Software Management and Information Cente Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 51-99 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 20K

The performance of the NASTRAN CQUAD4 membrane and plate element in the analysis of undamped natural vibration modes of thin fiber reinforced composite plates was evaluated. The element provides natural frequency estimates that are comparable in accuracy to alternative formulations, and, in most cases, deviate by less than 10 percent from experimentally measured frequencies. The predictions lie within roughly equal accuracy bounds for the two material types treated (GFRP and CFRP), and for the ply layups considered (unidirectional, cross-ply, and angle-ply). Effective elastic lamina moduli had to be adjusted for fiber volume fraction to attain this level of frequency. The lumped mass option provides more accurate frequencies than the consistent mass option. This evaluation concerned only plates with L/t ratios on the order of 100 to 150. Since the CQUAD4 utilizes first-order corrections for transverse laminate shear stiffness, the element should provide useful frequency estimates for plate-like structures with lower L/t. For plates with L/t below 20, consideration should be given to idealizing with 3-D solid elements. Based on the observation that natural frequencies and mode shapes are predicted with acceptable engineering accuracy, it is concluded that CQUAD4 should be a useful and accurate element for transient shock and steady state vibration analysis of naval ship Author

N92-24330*# Butler Analyses, Towson, MD.
A CASE OF POOR SUBSTRUCTURE DIAGNOSTICS
Thomas G. Butler *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 100-115 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 20K

The NASTRAN Manuals in the substructuring area are all geared toward instant success, but the solution paths are fraught with many traps for human error. Thus, the probability of suffering a fatal abort is high. In such circumstances, the necessity for diagnostics that are user friendly is paramount. This paper is written in the spirit of improving the diagnostics as well as the documentation in one area where the author felt he was backed into a blind corner as a result of his having committed a data oversight. This topic is aired by referring to an analysis of a particular structure. The structure, under discussion, used a number of local coordinate systems that simplified the preparation of input data. The principle features of this problem are introduced by reference to a series of figures. Author

N92-24331*# General Electric Co., Houston, TX. Government Services Div.
ALTERNATIVE METHODS TO MODEL FRICTIONAL CONTACT SURFACES USING NASTRAN
Joseph Hoang *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 116-123 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 20K

Elongated (slotted) holes have been used extensively for the integration of equipment into Spacelab racks. In the past, this type of interface has been modeled assuming that there is not slippage between contact surfaces, or that there is no load transfer in the direction of the slot. Since the contact surfaces are bolted together, the contact friction provides a load path determined by the normal applied force (bolt preload) and the coefficient of friction. Three alternate methods that utilize spring elements, externally applied couples, and stress dependent elements are examined to model the contacted surfaces. Results of these methods are compared with results obtained from methods that use GAP elements and rigid elements. Author

N92-24332*# General Electric Co., Houston, TX. Government Services Div.
HIERARCHICAL TAPERED BAR ELEMENTS UNDERGOING AXIAL DEFORMATION
N. Ganesan and S. K. Thampi *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 124-133 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 20K

A method is described to model the dynamics of tapered axial bars of various cross sections based on the well-known Craig/Bampton component mode synthesis technique. This element is formed in terms of the static constraint modes and interface restrained normal modes. This is in contrast with the finite elements as implemented in NASTRAN where the interface restrained normal modes are neglected. These normal modes are in terms of Bessel functions. Restoration of a few of these modes leads to higher accuracy with fewer generalized coordinates. The proposed models are hierarchical so that all lower order element matrices are embedded in higher order element matrices. The advantages of this formulation compared to standard NASTRAN truss element formulation are demonstrated through simple numerical examples. Author

N92-24333*# McDonnell-Douglas Space Systems Co., Huntsville, AL.
TRANSIENT THERMAL STRESS RECOVERY FOR STRUCTURAL MODELS
William Walls *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 134-153 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 20K

A method for computing transient thermal stress vectors from temperature vectors is described. The three step procedure involves the use of NASTRAN to generate an influence coefficient

matrix which relates temperatures to stresses in the structural model. The transient thermal stresses are then recovered and sorted for maximum and minimum values. Verification data for the procedure is also provided. Author

N92-24334*# General Electric Co., Houston, TX. Government Services Div.
TRANSIENT LOADS ANALYSIS FOR SPACE FLIGHT APPLICATIONS
S. K. Thampi, N. S. Vidyasagar, and N. Ganesan *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 154-165 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 20K

A significant part of the flight readiness verification process involves transient analysis of the coupled Shuttle-payload system to determine the low frequency transient loads. This paper describes a methodology for transient loads analysis and its implementation for the Spacelab Life Sciences Mission. The analysis is carried out using two major software tools - NASTRAN and an external FORTRAN code called EZTRAN. This approach is adopted to overcome some of the limitations of NASTRAN's standard transient analysis capabilities. The method uses Data Recovery Matrices (DRM) to improve computational efficiency. The mode acceleration method is fully implemented in the DRM formulation to recover accurate displacements, stresses, and forces. The advantages of the method are demonstrated through a numerical example. Author

N92-24335*# David Taylor Research Center, Bethesda, MD. Computational Mechanics Div.
ACOUSTIC INTENSITY CALCULATIONS FOR AXISYMMETRICALLY MODELED FLUID REGIONS **c71**
Stephen A. Hambric and Gordon C. Everstine *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 166-183 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 20A

An algorithm for calculating acoustic intensities from a time harmonic pressure field in an axisymmetric fluid region is presented. Acoustic pressures are computed in a mesh of NASTRAN triangular finite elements of revolution (TRIAAX) using an analogy between the scalar wave equation and elasticity equations. Acoustic intensities are then calculated from pressures and pressure derivatives taken over the mesh of TRIAAX elements. Intensities are displayed as vectors indicating the directions and magnitudes of energy flow at all mesh points in the acoustic field. A prolate spheroidal shell is modeled with axisymmetric shell elements (CONEAX) and submerged in a fluid region of TRIAAX elements. The model is analyzed to illustrate the acoustic intensity method and the usefulness of energy flow paths in the understanding of the response of fluid-structure interaction problems. The structural-acoustic analogy used is summarized for completeness. This study uncovered a NASTRAN limitation involving numerical precision issues in the CONEAX stiffness calculation causing large errors in the system matrices for nearly cylindrical cones. Author

N92-24345*# Old Dominion Univ., Norfolk, VA. Dept. of Mechanical Engineering and Mechanics.
PREDICTION OF RESPONSE OF AIRCRAFT PANELS SUBJECTED TO ACOUSTIC AND THERMAL LOADS Final Report, Dec. 1987 - Mar. 1992
Chuh Mei May 1992 49 p
(Grant NAG1-838)
(NASA-CR-190305; NAS 1.26:190305) Avail: NTIS HC/MF A03 CSCL 20K

The primary effort of this research project has been focused on the development of analytical methods for the prediction of random response of structural panels subjected to combined and intense acoustic and thermal loads. The accomplishments on various acoustic fatigue research activities are described first, then followed by publications and theses. Topics covered include: transverse shear deformation; finite element models of vibrating composite laminates; large deflection vibration modeling; finite element analysis of thermal buckling; and prediction of three dimensional duct using boundary element method. H.A.

N92-24544*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CSI COMPUTER SYSTEM/REMOTE INTERFACE UNIT ACCEPTANCE TEST RESULTS
Dean W. Sparks, Jr. Mar. 1992 128 p
(NASA-TM-104218; NAS 1.15:104218) Avail: NTIS HC/MF A07 CSCL 20K

The validation tests conducted on the Control/Structures Interaction (CSI) Computer System (CCS)/Remote Interface Unit (RIU) is discussed. The CCS/RIU consists of a commercially available, Langley Research Center (LaRC) programmed, space flight qualified computer and a flight data acquisition and filtering computer, developed at LaRC. The tests were performed in the Space Structures Research Laboratory (SSRL) and included open loop excitation, closed loop control, safing, RIU digital filtering, and RIU stand alone testing with the CSI Evolutionary Model (CEM) Phase-0 testbed. The test results indicated that the CCS/RIU system is comparable to ground based systems in performing real-time control-structure experiments. Author

N92-24546*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
STIFFNESS AND STRENGTH TAILORING IN UNIFORM SPACE-FILLING TRUSS STRUCTURES
Mark S. Lake Apr. 1992 30 p Presented at the Ninth DOD/NASA/FAA Conference on Fibrous Composites in Structural Design, Lake Tahoe, NV, 4-7 Nov. 1991
(NASA-TP-3210; L-17001; NAS 1.60:3210) Avail: NTIS HC/MF A03 CSCL 20K

A deterministic procedure for tailoring the continuum stiffness and strength of uniform space-filling truss structures, through the appropriate selection of truss geometry and member sizes (flexural stiffness, axial stiffness, and length), is presented. The trusses considered herein are generated by uniform replication of a characteristic truss cell. The repeating cells are categorized by one of a set of possible geometric symmetry groups derived using crystallographic techniques. The elastic symmetry associated with each geometric symmetry group is identified to help select an appropriate truss geometry for a given application. Stiffness and strength tailoring of a given truss geometry is enabled through explicit expressions relating the continuum stiffnesses and failure stresses of the truss to the stiffnesses and failure loads of its members. These expressions are derived using an existing equivalent continuum analysis technique and a newly developed analytical failure theory for trusses. Several examples are presented to illustrate the application of these techniques and to demonstrate the usefulness of the information gained from this analysis. Author

N92-24584# Sandia National Labs., Albuquerque, NM.
STRUCTURAL SYSTEM IDENTIFICATION OF A COMPOSITE SHELL
J. R. Red-Horse, T. G. Carne, G. H. James, and W. R. Witkowski 1991 9 p Presented at the 33rd Structural Dynamics and Materials Conference, Dallas, TX, 13-15 Apr. 1992
(Contract DE-AC04-76DP-00789)
(DE92-009060; SAND-91-1904C; CONF-920499-1) Avail: NTIS HC/MF A02

Structural system identification is undergoing a period of renewed interest. Probabilistic approaches to physical parameter identification in analysis finite element models make uncertainty in test results an important issue. In this paper, we investigate this issue with a simple, though in many ways representative, structural system. The results of two modal parameter identification techniques are compared and uncertainty estimates, both through bias and random errors, are quantified. The importance of the interaction between test and analysis is also highlighted. DOE

N92-24704# Westinghouse Savannah River Co., Aiken, SC.
STRESS ANALYSIS OF HYDRIDE BED VESSELS USED FOR TRITIUM STORAGE
S. T. McKillip, C. E. Bannister, and E. A. Clark 1991 8 p Presented at the 4th Topical Meeting on Tritium Technology in Fission, Fusion, and Isotopic Applications, Albuquerque, NM, 30 Sep. - 4 Oct. 1991
(Contract DE-AC09-89SR-18035)
(DE92-009831; WSRC-MS-91-015; CONF-910920-21) Avail: NTIS HC/MF A02

A prototype hydride storage bed, using LaNi(sub 4.25)Al(sub 0.75) as the storage material, was fitted with strain gages to measure strains occurring in the stainless steel bed vessel caused by expension of the storage powder upon uptake of hydrogen. The strain remained low in the bed as hydrogen was added, up to a bed loading of about 0.5 hydrogen to metal atom ratio (H/M). The strain then increased with increasing hydrogen loading (approximately 0.8 H/M). Different locations exhibited greatly different levels of maximum strain. In no case was the design stress of the vessel exceeded. DOE

N92-24706*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SYSTEM/OBSERVER/CONTROLLER IDENTIFICATION TOOLBOX
Jer-Nan Juang, Lucas G. Horta, and Minh Phan (Lockheed Engineering and Sciences Co., Hampton, VA.) Feb. 1992 87 p
(NASA-TM-107566; NAS 1.15:107566) Avail: NTIS HC/MF A05 CSCL 20K

System Identification is the process of constructing a mathematical model from input and output data for a system under testing, and characterizing the system uncertainties and measurement noises. The mathematical model structure can take various forms depending upon the intended use. The SYSTEM/OBSERVER/CONTROLLER IDENTIFICATION TOOLBOX (SOCIT) is a collection of functions, written in MATLAB language and expressed in M-files, that implements a variety of modern system identification techniques. For an open loop system, the central features of the SOCIT are functions for identification of a system model and its corresponding forward and backward observers directly from input and output data. The system and observers are represented by a discrete model. The identified model and observers may be used for controller design of linear systems as well as identification of modal parameters such as dampings, frequencies, and mode shapes. For a closed-loop system, an observer and its corresponding controller gain directly from input and output data. Author

N92-24707*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A CONSISTENT-MODE INDICATOR FOR THE EIGENSYSTEM REALIZATION ALGORITHM
Richard S. Pappa, Kenny B. Elliott, and Axel Schenk (Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen, Germany, F.R.) Apr. 1992 11 p Presented at the 33rd Structures, Structural Dynamics, and Materials Conference, Dallas, TX, 13-17 Apr. 1992
(NASA-TM-107607; NAS 1.15:107607) Avail: NTIS HC/MF A03 CSCL 20K

A new method is described for assessing the consistency of model parameters identified with the Eigensystem Realization Algorithm (ERA). Identification results show varying consistency in practice due to many sources, including high modal density, nonlinearity, and inadequate excitation. Consistency is considered to be a reliable indicator of accuracy. The new method is the culmination of many years of experience in developing a practical implementation of the Eigensystem Realization Algorithm. The effectiveness of the method is illustrated using data from NASA Langley's Controls-Structures-Interaction Evolutionary Model. Author

N92-24708*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
COUPLED LOADS ANALYSIS FOR SPACE SHUTTLE PAYLOADS
J. Eldridge May 1992 20 p
(NASA-TM-103581; NAS 1.15:103581) Avail: NTIS HC/MF A03 CSCL 20K

Described here is a method for determining the transient response of, and the resultant loads in, a system exposed to predicted external forces. In this case, the system consists of four racks mounted on the inside of a space station resource node module (SSRNMO) which is mounted in the payload bay of the space shuttle. The predicted external forces are forcing functions which envelope worst case forces applied to the shuttle during liftoff and landing. This analysis, called a coupled loads analysis, is used to couple the payload and shuttle models together, determine the transient response of the system, and then recover payload loads, payload accelerations, and payload to shuttle interface forces. Author

N92-24798*# Southwest Research Inst., San Antonio, TX.
PROBABILISTIC STRUCTURAL ANALYSIS METHODS FOR SELECT SPACE PROPULSION SYSTEM COMPONENTS (PSAM). VOLUME 3: LITERATURE SURVEYS AND TECHNICAL REPORTS Final Report
Apr. 1992 189 p
(Contract NAS3-24389)
(NASA-CR-189159; NAS 1.26:189159) Avail: NTIS HC/MF A09 CSCL 20K

The technical effort and computer code developed during the first year are summarized. Several formulations for Probabilistic Finite Element Analysis (PFEA) are described with emphasis on the selected formulation. The strategies being implemented in the first-version computer code to perform linear, elastic PFEA is described. The results of a series of select Space Shuttle Main Engine (SSME) component surveys are presented. These results identify the critical components and provide the information necessary for probabilistic structural analysis. Author

N92-24804*# Southwest Research Inst., San Antonio, TX.
PROBABILISTIC STRUCTURAL ANALYSIS METHODS FOR SELECT SPACE PROPULSION SYSTEM COMPONENTS (PSAM). VOLUME 2: LITERATURE SURVEYS OF CRITICAL SPACE SHUTTLE MAIN ENGINE COMPONENTS Final Report
K. R. Rajagopal (Rockwell International Corp., Canoga Park, CA.) Apr. 1992 430 p
(Contract NAS3-24389)
(NASA-CR-189158; NAS 1.26:189158) Avail: NTIS HC/MF A19 CSCL 20K

The technical effort and computer code development is summarized. Several formulations for Probabilistic Finite Element Analysis (PFEA) are described with emphasis on the selected formulation. The strategies being implemented in the first-version computer code to perform linear, elastic PFEA is described. The results of a series of select Space Shuttle Main Engine (SSME) component surveys are presented. These results identify the critical components and provide the information necessary for probabilistic structural analysis. Volume 2 is a summary of critical SSME components. Author

N92-24880*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MEASUREMENT OF MULTIAXIAL PLY STRENGTH BY AN OFF-AXIS FLEXURE TEST
John H. Crews, Jr. and Rajiv A. Naik (Analytical Services and Materials, Inc., Hampton, VA.) Mar. 1992 30 p Presented at the 11th ASTM Symposium on Composite Materials: Testing and Design, Pittsburgh, PA, 4-5 May 1992
(NASA-TM-107570; NAS 1.15:107570) Avail: NTIS HC/MF A03 CSCL 20K

An off-axis flexure (OAF) test was performed to measure ply strength under multiaxial stress states. This test involves unidirectional off-axis specimens loaded in bending, using an

apparatus that allows these anisotropic specimens to twist as well as flex without the complications of a resisting torque. A 3D finite element stress analysis verified that simple beam theory could be used to compute the specimen bending stresses at failure. Unidirectional graphite/epoxy specimens with fiber angles ranging from 90 deg to 15 deg have combined normal and shear stresses on their failure planes that are typical of 45 deg plies in structural laminates. Tests for a range of stress states with AS4/3501-6 specimens showed that both normal and shear stresses on the failure plane influenced cracking resistance. This OAF test may prove to be useful for generating data needed to predict ply cracking in composite structures and may also provide an approach for studying fiber-matrix interface failures under stress states typical of structures. Author

N92-24967# Technische Univ., Delft (Netherlands).
LOCAL APPROACH TO FATIGUE OF CONCRETE Ph.D. Thesis
Dirk Arend Hordijk 1991 217 p Sponsored by Netherlands Center for Civil Engineering, Research, Codes and Specifications and Stichting Professor Bakkerfonds
(Grant STW-DCT-38-0552)
(ISBN-90-9004519-8; ETN-92-91302) Copyright Avail: NTIS HC/MF A10

The development of a model based on fracture mechanics to improve knowledge on the causes and mechanism of concrete fatigue is addressed. The tensile behavior of concrete is discussed and the fatigue behavior of concrete and available models are reviewed. The deformation controlled uniaxial tensile test is found to be always accompanied by a so called structural behavior and this phenomenon is discussed. A constitutive model for the tensile behavior (including post peak cyclic loading) is proposed. The way in which a number of variables affect the tensile behavior of concrete, or the fracture parameters included in it, is discussed. Results of experiments and finite element code simulations on the proposed model, in which mode 1 fracture is the leading mechanism, are given. Numerical predictions of the fatigue behavior of plain concrete are presented. Experimental results of measuring deformation during fatigue loading are given. ESA

N92-24985*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
DAMAGE MECHANISMS IN BITHERMAL AND THERMOMECHANICAL FATIGUE OF HAYNES 188
Sreeramesh Kalluri (Sverdrup Technology, Inc., Brook Park, OH.) and Gary R. Halford 1992 19 p Presented at the Symposium on Thermo-Mechanical Fatigue Behavior of Materials, San Diego, CA, 16 Oct. 1991; sponsored in part by American Society for Testing and Materials
(NASA-TM-105381; E-6768; NAS 1.15:105381) Avail: NTIS HC/MF A03 CSCL 20K

Post failure fractographic and metallographic studies were conducted on Haynes 188 specimens fatigued under bithermal and thermomechanical loading conditions between 316 and 760 C. Bithermal fatigue specimens examined included those tested under high strain rate in-phase and out-phase, tensile creep in-phase, and compressive creep out-of-phase loading conditions. Specimens tested under in-phase and out-of-phase thermomechanical fatigue were also examined. The nature of failure mode (transgrandular versus intergranular), the topography of the fracture surface, and the roles of oxidation and metallurgical changes were studied for each type of bithermal and thermomechanical test. Author

N92-25017# Oak Ridge Y-12 Plant, TN.
SPECIMEN TYPE AND SIZE EFFECTS ON LITHIUM HYDRIDE TENSILE STRENGTH DISTRIBUTIONS
R. E. Oakes, Jr. Dec. 1991 45 p
(Contract DE-AC05-84OS-21400)
(DE92-008200; Y-2440) Avail: NTIS HC/MF A03

Weibull's two-parameter statistical-distribution function is used to account for the effects of specimen size and loading differences on strength distributions of lithium hydride. Three distinctly differing uniaxial specimen types (i.e., an elliptical-transition pure tensile specimen, an internally pressurized ring tensile, and two sizes of four-point-flexure specimens) are shown to provide different strength distributions as expected, because of their differing sizes and modes of loading. After separation of strengths into volumetric- and surface-initiated failure distributions, the Weibull characteristic strength parameters for the higher-strength tests associated with internal fracture initiations are shown to vary as predicted by the effective specimen volume Weibull relationship. Lower-strength results correlate with the effective area to a lesser degree, probably because of the limited number of surface-related failures and the different machining methods used to prepare the specimen. The strength distribution from the fourth specimen type, the predominantly equibiaxially stressed disk-flexure specimen, is well below that predicted by the two-parameter Weibull-derived effective volume or surface area relations. The two-parameter Weibull model cannot account for the increased failure probability associated with multiaxial stress fields. Derivations of effective volume and area relationships for those specimens for which none were found in the literature, the elliptical-transition tensile, the ring tensile, and the disk flexure (including the outer region), are also included. DOE

N92-25024# Case Western Reserve Univ., Cleveland, OH. Dept. of Macromolecular Science.
FATIGUE ACCELERATED BRITTLE FAILURE OF POLYETHYLENE COPOLYMER PIPES Final Report, Apr. 1989 - Apr. 1990
A. Moet, J. J. Strebel, and E. Showaib Apr. 1990 66 p
(Contract GRI-5083-260-0940)
(PB92-149673; GRI-91/0030) Avail: NTIS HC/MF A04 CSCL 20K

Medium density polyethylene pipes are widely used in natural gas distribution systems. It is desired that such systems have a minimum service lifetime of about fifty years with minimal maintenance. However, in some inferior pipe materials slow brittle crack propagation may significantly reduce the service lifetime of a system. The mechanism of fatigue failure in polyethylene copolymer pipes is described in detail. Failure occurs by a discontinuous damage growth/crack step phenomenon. Under plane strain conditions, the damage ahead of the crack tip consists of a craze zone, while in plane stress, material yielding is the predominant damage form. The crazes are composed of yielded membranes which are oriented perpendicular to the crack propagation direction. Yielding encompasses a large zone on the specimen edges, but it is a more diffuse type of damage which results in a slight material densification. Both types of damage are quantified and related to the kinetic parameters of crack propagation, using the Crack Layer Theory. The resulting specific enthalpy of damage is shown to be independent of the specimen geometry and thus representative of the material. GRA

N92-25058# Sandia National Labs., Albuquerque, NM.
STRESS RELAXATION OF BRAZE JOINTS
J. J. Stephens, S. N. Burchett, and W. B. Jones 1991 10 p Presented at the American Society of Mechanical Engineers/Japan Society of Mechanical Engineers (ASME/JSME) Joint Conference on Electronic Packaging, San Jose, CA, 9-12 Apr. 1992
(Contract DE-AC04-76DP-00789)
(DE92-007989; SAND-92-0190C; CONF-920452-3) Avail: NTIS HC/MF A02

Calculations of residual stresses in braze joints are required to validate designs for a variety of metal/ceramic joining applications. In particular, finite element analysis (FEA) codes have the capability of incorporating either elastic-plastic or minimum creep rate constitutive models for the braze material. This paper presents both elevated temperature mechanical properties correlations for the eutectic Ag-Cu alloy, along with FEA results which use this data in calculating residual stresses in a generic metal/ceramic 'shear' type braze joint. Three constitutive relations have been developed for eutectic Ag-Cu alloy: (1) an elastic/plastic correlation incorporating temperature dependent yield stress and work hardening data; (2) a high temperature minimum creep rate correlation with a temperature dependent stress exponent; and

(3) a minimum creep rate correlation using the Garofalo hyperbolic sine (sinh) equation. FEA calculations are presented for a eutectic Ag-Cu braze joint between metallized alumina ceramic and either Fe-29Ni-17Co or Fe-27Ni-25Co alloys using the three different constitutive relations for the brazement. The two creep correlations, since they are time-dependent, permit a study of the effect of various cooldown cycles on the maximum residual stress in the alumina ceramic. For the cooldown profiles studied in this paper, lower residual stresses are predicted in the ceramic (relative to the elastic-plastic model) when either of the two creep models are used as the constitutive law for the eutectic Ag-Cu braze joint. A second important result is that the simulations which incorporate the Fe-29Ni-17Co alloy show higher peak stresses than the Fe-27Ni-25Co alloy at 420 C, along with much lower peak stresses compared to Fe-27Ni-25Co alloy at room temperature. The reason for this somewhat surprising behavior can be understood in terms of the coefficient of thermal expansion for the two Fe-Ni-Co alloys. DOE

N92-25067*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE 26TH AEROSPACE MECHANISMS SYMPOSIUM
Washington May 1992 386 p Symposium held in Greenbelt, MD, 13-15 May 1992; sponsored by NASA, Washington, California Inst. of Tech., and LMSC
(NASA-CP-3147; Rept-92B00052; NAS 1.55:3147) Avail: NTIS HC/MF A17 CSCL 20K

The proceedings of the 26th Aerospace Mechanisms Symposium, which was held at the Goddard Space Flight Center on May 13, 14, and 15, 1992 are reported. Technological areas covered include actuators, aerospace mechanism applications for ground support equipment, lubricants, latches, connectors and other mechanisms for large space structures. For individual titles, see N92-25068 through N92-25091.

N92-25068*# TiNi Alloy Co., Oakland, CA.
DEVELOPMENT OF A NON-EXPLOSIVE RELEASE DEVICE FOR AEROSPACE APPLICATIONS **c37**
John D. Busch, William E. Purdy (Naval Research Lab., Washington, DC.), and A. David Johnson *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 1-16 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

A simple, non-explosive, high load capacity release mechanism using a shape memory alloy is currently being developed for space flight. This device, the Frangibolt, could replace most pyrotechnic devices in applications where the need for safety, reliability, non-destructive testing, and minimal mechanical shock is more crucial than the need for rapid actuation. Prototype hardware has been designed, tested, and proven in laboratory conditions. Orientation and demonstration of these devices evidenced reliable and repeatable performance, clearly indicating that extensive testing for flight qualification is warranted. Here, the Frangibolt design is discussed, recent test results of laboratory units are described, and the work that must be performed in the upcoming months to qualify the device for aerospace applications is addressed. Author

N92-25069*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
NOVEL AEROSPACE MECHANISMS: A PASSIVE TETHER DAMPING DEVICE FOR TETHERED SATELLITE, AND A PIN/LATCH STRUCTURAL INTERFACE SYSTEM **c37**
John W. Redmon, Jr. *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 17-32 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

Presented here is a collection of development tasks that have been accomplished over the past year at the Marshall Space Flight Center's Structures and Dynamics Laboratory. Dissemination of task findings are reported for the following reasons: the task involves new or evolving technology (as in the case of a tethered satellite), and the tasks depict a technique that could have application to extravehicular activity (EVA) or robotic assembly of space structures (the pin/latch system). Author

N92-25070*# Aerospatiale, Cannes (France). Space and Strategic Systems Div.
DEPLOYMENT HINGE USING WRAPAROUND STRIPS [ADELE: ARTICULATION DE DEPLOIEMENT A LAMES D'ENROULEMENT] **c37**
Eric Blanc *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 33-44 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

Aerospatiale developed a new appendage deployment concept called AMEDE (French acronym for improvement of deployment mechanisms) with a view toward increased simplicity and functional reliability. This new concept, applicable to the deployment of any type of spaceborne appendage (in particular to solar arrays), enables deployment without synchronization or speed regulation devices. On the other hand, it requires the use of hinges with low driving or resistive torques. The AMEDE concept is compared with the conventional deployment concept. The conceptual and functional principles for the ADELE hinge are presented, as well as the hinges' main characteristics. The development status of both the AMEDE concept and the ADELE (French acronym for deployment hinge using wraparound strips) hinge are addressed. Author

N92-25071*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
DEPLOYMENT AND RETRIEVAL MECHANISM REDESIGNED FOR SPARTAN SPACECRAFT ON THE STS **c37**
Greg Galloway *In its* The 26th Aerospace Mechanisms Symposium May 1992 p 45-60 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

The Spartan Release Engage Mechanism (REM) is a system designed to restrain the Spartan spacecraft during Space Transportation System (STS) launch and landing. The mechanism is designed to allow deployment and retrieval of the Spartan free flyer spacecraft from the shuttle payload bay. Because current Spartan spacecraft payloads are much heavier than payloads intended for the original REM, an extensive redesign, analysis, and test program was necessary. Also, increased emphasis on safety in the post-Challenger era prompted a reevaluation of possible failures. Much of the design effort focused on improving the latch mechanism gearbox. Key concerns were effective gear lubrication, thermal gradients at the gearbox mounts, operation at thermal extremes, and gear-train failure contingencies. Increased concern for reliability led to the design of an Extra Vehicular Activity (EVA) backup latch system. Author

N92-25072*# Maryland Univ., College Park. Space Systems Lab.
MANIPULATOR DESIGN AND DEVELOPMENT FOR THE RANGER SATELLITE SERVICING VEHICLE **c37**
Russell D. Howard and David L. Akin *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 61-74 (For primary document see N92-25067 15-39)
(Grant NAGw-2245)
Avail: NTIS HC/MF A17 CSCL 13I

The Ranger program is a planned series of low cost telerobotics flight experiments, based on the use of Pegasus launch vehicles. As the first step towards this goal, the Space Systems Lab was developing a neutral buoyancy version of Ranger for use in design verification and operations testing. The design approach and results of the Ranger manipulator development program is related. Ranger is designed to incorporate four appendages: a pair of dexterous, seven degree of freedom manipulators for general manipulation; a six DOF grappling arm for securing the vehicle to the local work site; and a five DOF positioning manipulator for the stereo camera pair that provide feedback to the remote operator. Each of these manipulators incorporate unique approaches to satisfying

design requirements. The numerical and operational requirements are given for Ranger manipulators, and the evolution is discussed of the differing design approaches based on similarities and differences in the requirements. Testing results for individual joints and manipulator assemblies are presented, followed by initial results of operational testing on satellite servicing tasks with the integrated Ranger neutral buoyancy vehicle. Author

N92-25073*# Dornier-Werke G.m.b.H., Friedrichshafen (Germany, F.R.).
EXPERIENCES IN THE DEVELOPMENT OF ROTARY JOINTS FOR ROBOTIC MANIPULATORS IN SPACE APPLICATIONS **c37**
Klaus Priesett *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 75-89 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

European developments in robotics for space applications have resulted in human arm-like manipulators with six or more rotational degrees of freedom. The rotary joints including their own electromechanical actuator and feedback sensors must be very compact units. The specific joint concept is presented as evolved so far. The problems encountered during the first hardware development phases are covered on both component and joint level. Author

N92-25074*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SPLINE-LOCKING SCREW FASTENING STRATEGY **c37**
John M. Vranish *In its* The 26th Aerospace Mechanisms Symposium May 1992 p 91-110 Previously announced as N92-22690 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

A fastener was developed by NASA Goddard for efficiently performing assembly, maintenance, and equipment replacement functions in space using either robotics or astronaut means. This fastener, the 'Spline Locking Screw' (SLS) would also have significant commercial value in advanced space manufacturing. Commercial (or DoD) products could be manufactured in such a way that their prime subassemblies would be assembled using SLS fasteners. This would permit machines and robots to disconnect and replace these modules/parts with ease, greatly reducing life cycle costs of the products and greatly enhancing the quality, timeliness, and consistency of repairs, upgrades, and remanufacturing. The operation of the basic SLS fastener is detailed, including hardware and test results. Its extension into a comprehensive fastening strategy for NASA use in space is also outlined. Following this, the discussion turns toward potential commercial and government applications and the potential market significance of same. Author

N92-25075*# Honeywell, Inc., Glendale, AZ. Satellite System Operation.
MODULAR ANTENNA POINTING SYSTEM FOR THE EXPLORER PLATFORM SATELLITE **c37**
James Andrus and Ed Korzeniowski *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 111-126 Sponsored in part by Fairchild Space Co. (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

A Modular Antenna Pointing System (MAPS) is described which was designed for on-orbit servicing and on-orbit exchange. The MAPS provides a data link between the Explorer Platform (EP) satellite and the Tracking and Data Relay Satellite (TDRS). The MAPS consists of a two axis gimbal set used to position a High Gain Antenna (HGA) toward TDRS, system control electronics, and an extendable mast. The system was qualified and integrated with the EP satellite for an April 1992 launch. Author

N92-25076*# Aerospatiale, Cannes (France). Space and Strategic Systems Div.
WEARING OF CRYOMECHANISMS AT 4 K **c37**
Gerard Luciano *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 127-137 Previously announced as N90-24139 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

Certain spaceborne optics include components that are designed to improve the instrument's performance. Where such mechanisms cannot be decoupled from the optical devices, pollution from the wear of those mechanisms must be minimized due to impossibility of inflight, or even sometimes on-ground cleaning of optical devices. Aerospatiale, who are responsible for the optical bench of the infrared camera to be flown on board the ISO spacecraft, were therefore led to develop nonpolluting mechanisms. Comparative tests were performed on several couples of materials, resulting in choice of a satisfactory solution. Author

N92-25077*# AEC-Able Engineering Co., Inc., Goleta, CA.
INVACUO TRIBOLOGICAL EVALUATION OF COARSE-PITCH GEARS FOR USE ON THE SPACE STATION ALPHA JOINT **c37**
Scotty R. Allen *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 139-155 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

Existing invacuo or ambient test data of slow-speed (less than 30 meters/minute pitch line velocity), coarse-pitch gears could not be found suitable for use in evaluating gear materials and surface treatments for the gear-driven bearing race of the Solar Alpha Rotary Joint (SARJ) for Space Station Freedom (SSF). Gear testing was conducted by AEC-Able Engineering Company, Inc. to obtain design data for this critical SSF component. Some bull gear/pinion/lubrication combinations endured over 600,000 cycles (100 SSF years) without measurable wear, while other combinations experienced surface treatment degradation after only 40,000 cycles (seven SSF years). No catastrophic failures, such as seizing or tooth breakage, occurred during any test, all of which were run at least 201,000 cycles (34.5 SSF years). Specific results such as debris characteristics, mechanical efficiencies, effectiveness and degradation of lubrication, and wear data for the various gear combinations tested are described. Author

N92-25078*# Ithaco, Inc., Ithaca, NY.
A COMBINED EARTH SCANNER AND MOMENTUM WHEEL FOR ATTITUDE DETERMINATION AND CONTROL OF SMALL SPACECRAFT **c19**
Bill Bialke *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 157-172 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 22B

In order to satisfy the stringent cost and power requirements of small satellites, an advanced SCANWHEEL was designed, built, and qualified by ITHACO, Inc. The T-SCANWHEEL is a modular momentum/reaction wheel with an integral conical Earth scanner. The momentum wheel provides momentum bias and control torques about the pitch axis of a spacecraft. An angled scan mirror coupled to the rotating shaft of the momentum wheel provides a conical scan of the field-of-view of an infrared sensor to provide pitch-and-roll attitude information. By using the same motor and bearings for the momentum wheel and Earth scanner, the overall power consumption is reduced and the system reliability is enhanced. The evolution of the T-SCANWHEEL is presented, including design ground rules, tradeoff analyses, and performance results. Author

N92-25079*# Lockheed Missiles and Space Co., Sunnyvale, CA.
STEPPER MOTOR INSTABILITIES IN AN AEROSPACE APPLICATION **c33**
Russell Kackley and Sean McCully *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 173-187 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 09A

Stepper motors are frequently used in positioning mechanisms

because they have several advantages over ordinary DC motors. However, there is frequently no feedback loop and the motor may exhibit instabilities under some conditions. A stepper motor in an aerospace positioning mechanism was investigated. During testing, the motor exhibited unstable behavior, such as backrunning and forward running. The instability was dependent on voltage pulse characteristics, temperature, positioning angle, step rate, and interaction between the two motors in the system. Both testing and analysis results verified the instability. A special purpose FORTRAN code was written to simulate the system. This code was combined with another simpler code to show the performance of the system in the phase plane so that instability boundaries could be displayed along with the motor performance. The analysis was performed to verify that proposed modifications would produce stable performance before implementation in the hardware. Subsequent testing verified the analytic stability predictions.
Author

N92-25080*# Ball Aerospace Systems Div., Boulder, CO. Electro-Optics/Cryogenics Div.
SOHO MAMA OPENABLE COVER/VACUUM SEAL MECHANISM **c37**
Mitchell T. Wiens *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 189-203 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

The requirements, design, and test results of an openable cover mechanism with a high-vacuum seal developed for the Multi-Anode Microchannel Array (MAMA) Detectors, aboard the Solar and Heliospheric Observatory (SOHO) spacecraft. The mechanism, tested in summer/fall of 1991, has completed 1000 test cycles in an inert atmosphere at room temperature and pressure. Measured mechanism performance included: vacuum seal less than 5 x 10 exp -10 torr-liter/second, 103 degree angular range of travel, 20-minute cycle time, and successful latching functions. An openable cover mechanism that provides a clean, high-vacuum seal is vital to the success of a MAMA Detector operating over a full wavelength coverage from 500 to 1600 A. Author

N92-25081*# Ball Aerospace Systems Div., Boulder, CO.
ARM DEPLOY MECHANISMS TO HELP CORRECT THE HUBBLE SPACE TELESCOPE'S VISION **c37**
F. Kent Copeland and Randall R. Whitaker *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 205-220 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

As has been well publicized, the primary mirror of the Hubble Space Telescope was manufactured with an incorrect curvature which results in an aberrated output image. Ball Aerospace, under contract to GSFC, is designing the Corrective Optics Space Telescope Axial Replacement (COSTAR) to provide correcting optics for the existing axial science instruments in the telescope. Integral to COSTAR are the arm deploy mechanisms which position and hold the corrective optic mirrors. Author

N92-25082*# Starsys Research Corp., Boulder, CO.
DEVELOPMENT OF A RESETTABLE, FLEXIBLE APERTURE COVER **c37**
Scott Christiansen *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 221-234 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

A flexible aperture cover and latch were developed for the Thermal Ion Detection Experiment (TIDE). The latch utilized a high-output paraffin (HOP) linear motor to supply the force to operate the latch. The initial approach for the cover was to use a heat-treated, coiled strip of 0.05 mm (.002-inch)-thick beryllium-copper as the cover. Development test results showed that one end of the cover developed a trajectory during release that threatened to impact against adjacent instruments. An alternative design utilizing constant force springs and a flexible, metallized Kapton cover was then tested. Results from development tests, microgravity tests, and lessons learned during the development of the aperture cover are discussed. Author

N92-25083*# Lockheed Missiles and Space Co., Sunnyvale, CA.
MILSTAR'S FLEXIBLE-SUBSTRATE SOLAR ARRAY: LESSONS LEARNED **c37**
John Gibb *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 235-243 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

The Flexible Substrate Solar Array (FSSA) is an evolutionary development of the lightweight, flexible substrate design pioneered during the seventies. Many of the features of the design are related to the Solar Array Flight Experiment (SAFE), flown on STS-41D in 1984. FSSA development has created a substantial technology base for future flexible substrate solar arrays such as the array for the Space Station Freedom. Lessons learned during the development of the FSSA can and should be applied to the Freedom array and other future flexible substrate designs.
Author

N92-25084*# Honeywell, Inc., Glendale, AZ. Satellite Systems Operation.
MECHANISMS OF THE SPACE ACTIVE VIBRATION ISOLATION (SAVI)
Frank Schmitt *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 245-262 Sponsored in part by Phillips Lab. (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 20K

The Space Active Vibration Isolation (SAVI) is a concept for vibration isolation of one body from another with simultaneous precise control in 6 Degrees Of Freedom (DOF). SAVI achieves this using a combination of electromechanical linear actuators and magnetic actuators. Other mechanisms of interest include a structure for simulating the body being pointed, an apparatus to simulate the body that is the vibration source, and mechanisms to off-load the weight of each of these two bodies from the experiment to approximate a zero-g condition. A SAVI was built and tested to demonstrate these capabilities. Author

N92-25085*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
A 23.2:1 RATIO, 300-WATT, 26 N-m OUTPUT TORQUE, PLANETARY ROLLER-GEAR ROBOTIC TRANSMISSION: DESIGN AND EVALUATION **c37**
Wyatt S. Newman, William J. Anderson, William Shipitalo (NASTEC, Inc., Cleveland, OH.), and Douglas Rohn *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 263-279 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

The design philosophy and measurements performed on a new roller-gear transmission prototype for a robotic manipulator are described. The design incorporates smooth rollers in a planetary configuration integrated with conventional toothed gears. The rollers were designed to handle low torque with low backlash and friction while the complementary gears support higher torques and prevent accumulated creep or slip of the rollers. The introduction of gears with finite numbers of teeth to function in parallel with the rollers imposes severe limits on available designs. Solutions for two-planet row designs are discussed. A two-planet row, four-planet design was conceived, fabricated, and tested. Detailed calculations of cluster geometry, gear stresses, and gear geometry are given. Measurement data reported here include transmission linearity, static and dynamic friction, inertia, backlash, stiffness, and forward and reverse efficiency. Initial test results are reported describing performance of the transmission in a servomechanism with torque feedback. Author

N92-25086*# Boeing Co., Huntsville, AL.
SPACE STATION FREEDOM COMMON BERTHING MECHANISM **c18**
Erik Illi *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 281-296 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 22B

The Common Berthing Mechanism (CBM) is a generic device used to join the pressurized elements of the Space Station Freedom (SSF) utilizing the Space Shuttle Orbiter Remote Manipulator System (SRMS) or the Space Station Remote Manipulator System (SSRMS). The two berthing halves, the active, and the passive, maintain a pressurized atmosphere to allow astronaut passage, as well as to provide a structural linkage between elements. The generic design of the CBM allows any Passive Berthing Mechanism to berth with any Active Berthing Mechanism, permitting a variety of pressurized module patterns to be built. Author

N92-25087*# Sener S.A., Bilbao (Spain).
A MULTIPURPOSE MODEL OF HERMES-COLUMBUS DOCKING MECHANISM **c18**
J. J. Gonzalez-Vallejo, W. Fehse, and A. Tobias (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 297-313 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 22B

One of the foreseen missions of the HERMES spacevehicle is the servicing to the Columbus Free Flying Laboratory (MTFF). Docking between the two spacecraft is a critical operation in which the Docking Mechanism (DM) has a major role. In order to analyze and assess robustness of initially selected concepts and to identify suitable implementation solutions, through the investigation of main parameters involved in the docking functions, a multipurpose model of DM was developed and tested. This paper describes the main design features as well as the process of calibrating and testing. Author

N92-25088*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
DESIGN, DEVELOPMENT, AND FABRICATION OF EXTRAVEHICULAR ACTIVITY TOOLS FOR THE TRANSFER ORBIT STAGE **c37**
L. M. Albritton, J. W. Redmon, and T. R. Tyler *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 315-329 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 13I

Seven extravehicular activity (EVA) tools and a tool carrier have been designed and developed by MSFC in order to provide a two fault tolerant system for the transfer orbit stage (TOS) shuttle mission. The TOS is an upper stage booster for delivering payloads to orbits higher than the shuttle can achieve. Payloads are required not to endanger the shuttle even after two failures have occurred. The Airborne Support Equipment (ASE), used in restraining and deploying TOS, does not meet this criteria. The seven EVA tools designed will provide the required redundancy with no impact to the TOS hardware. Author

N92-25089*# Lockheed Missiles and Space Co., Palo Alto, CA.
DEVELOPMENT OF A PRECISION, SIX-AXIS LABORATORY DYNAMOMETER **c35**
P. J. Champagne, S. A. Cordova, M. S. Jacoby, and K. R. Lorell *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 331-348 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 07D

This paper describes the design, fabrication, test, and operation of a unique six axis force/torque dynamometer The specimen table used to hold components under test is supported in a full six axis kinematic mount. Support struts fabricated from high strength steel with special integral two axis flexures link the specimen table to the load cell transducers. Realtime force/torque coordinate transform, root mean squared calculation, and data averaging, and color six axis display with controllable scaling are provided by a specially programmed desktop computer. The extensive structural analysis and design optimization required to obtain a stiff, well damped, lightweight structure is described in detail. Geometric optimization of the kinematic mount and fabrication details of the struts are also described. Author

N92-25090*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MECHANICAL DESIGN OF A ROTARY BALANCE SYSTEM FOR NASA. LANGLEY RESEARCH CENTER'S VERTICAL SPIN TUNNEL **c09**
J. W. Allred and V. J. Fleck *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 349-366 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 14B

A new lightweight Rotary Balance System is presently being fabricated and installed as part of a major upgrade to the existing 20 Foot Vertical Spin Tunnel. This upgrade to improve model testing productivity of the only free spinning vertical wind tunnel includes a modern fan/drive and tunnel control system, an updated video recording system, and the new rotary balance system. The rotary balance is a mechanical apparatus which enables the measurement of aerodynamic force and moment data under spinning conditions (100 rpm). This data is used in spin analysis and is vital to the implementation of large amplitude maneuvering simulations required for all new high performance aircraft. The new rotary balance system described in this report will permit greater test efficiency and improved data accuracy. Rotary Balance testing with the model enclosed in a tare bag can also be performed to obtain resulting model forces from the spinning operation. The rotary balance system will be stored against the tunnel sidewall during free flight model testing. Author

N92-25091*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE 12-FOOT PRESSURE WIND TUNNEL RESTORATION PROJECT MODEL SUPPORT SYSTEMS **c09**
Glen E. Sasaki *In* NASA. Goddard Space Flight Center, The 26th Aerospace Mechanisms Symposium May 1992 p 367-381 (For primary document see N92-25067 15-39)
Avail: NTIS HC/MF A17 CSCL 14B

The 12 Foot Pressure Wind Tunnel is a variable density, low turbulence wind tunnel that operates at subsonic speeds, and up to six atmospheres total pressure. The restoration of this facility is of critical importance to the future of the U.S. aerospace industry. As part of this project, several state of the art model support systems are furnished to provide an optimal balance between aerodynamic and operational efficiency parameters. Two model support systems, the Rear Strut Model Support, and the High Angle of Attack Model Support are discussed. This paper covers design parameters, constraints, development, description, and component selection. Author

N92-25093*# Akron Univ., OH. Dept. of Civil Engineering.
A GEOMETRIC NONLINEAR DEGENERATED SHELL ELEMENT USING A MIXED FORMULATION WITH INDEPENDENTLY ASSUMED STRAIN FIELDS Final Report; Ph.D. Thesis, 1989
Wiley E. Graf Dec. 1991 122 p
(Grant NAG3-307)
(NASA-CR-189086; NAS 1.26:189086) Avail: NTIS HC/MF A06 CSCL 20K

A mixed formulation is chosen to overcome deficiencies of the standard displacement-based shell model. Element development is traced from the incremental variational principle on through to the final set of equilibrium equations. Particular attention is paid to developing specific guidelines for selecting the optimal set of strain parameters. A discussion of constraint index concepts and their predictive capability related to locking is included. Performance characteristics of the elements are assessed in a wide variety of linear and nonlinear plate/shell problems.

Despite limiting the study to geometric nonlinear analysis, a substantial amount of additional insight concerning the finite element modeling of thin plate/shell structures is provided. For example, in nonlinear analysis, given the same mesh and load step size, mixed elements converge in fewer iterations than equivalent displacement-based models. It is also demonstrated that, in mixed formulations, lower order elements are preferred. Additionally, meshes used to obtain accurate linear solutions do not necessarily converge to the correct nonlinear solution. Finally, a new form of locking was identified associated with employing elements designed for biaxial bending in uniaxial bending applications. Author

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N92-24200*# Hydex Corp., Vienna, VA.
AIRBORNE GAMMA RADIATION MEASUREMENTS OF SOIL MOISTURE DURING FIFE: ACTIVITIES AND RESULTS Final Report
Eugene L. Peck Apr. 1992 28 p
(Contract NAS5-30959)
(NASA-CR-190198; NAS 1.26:190198) Avail: NTIS HC/MF A03 CSCL 08M

Soil moisture measurements were obtained during the summer of 1987 and 1989 near Manhattan, Kansas, using the National Weather Service (NWS) airborne gamma radiation system. A network of 24 flight lines were established over the research area. Airborne surveys were flown daily during two intensive field campaigns. The data collected was sufficient to modify the NWS standard operational method for estimating soil moisture for the Field Experiment (FIFE) flight lines. The average root mean square error of the soil moisture estimates for shorter FIFE flight lines was found to be 2.5 percent, compared with a reported value of 3.9 percent for NWS flight lines. Techniques were developed to compute soil moisture estimates for portions of the flight lines. Results of comparisons of the airborne gamma radiation soil moisture estimates with those obtained using the NASA Pushbroom Microwave Radiation (PBMR) system and hydrological model are presented. The airborne soil moisture measurements, and real averages computed using all remotely sensed and ground data, have been in support of the research of the many FIFE investigators whose overall goal was the upscale integration of models and the application of satellite remote sensing. Author

N92-24248# General Accounting Office, Washington, DC. Information Management and Technology Div.
EARTH OBSERVING SYSTEM: BROADER INVOLVEMENT OF THE EOSDIS USER COMMUNITY IS NEEDED. REPORT TO THE CHAIRMAN, COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY, HOUSE OF REPRESENTATIVES
11 May 1992 19 p
(GAO/IMTEC-92-40; B-247881) Avail: NTIS HC/MF A03; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first copy free, additional copies $2.00

The Committee on Science, Space, and Technology requested that the General Accounting Office (GAO) review various aspects of NASA's EOSDIS program. To obtain background on user involvement in past data systems planning, GAO reviewed reports by the National Academy of Sciences' National Research Council, including reports by the Committee on Data Management and Computation. To determine the extent of user involvement in EOSDIS, GAO reviewed the NASA process for obtaining the input during the early design and development phase of the system and also reviewed NASA's future plans for obtaining user involvement. The GAO audit was performed in accordance with generally accepted government auditing between July 1991 and March 1992 at various locations. H.A.

N92-24674# Los Alamos National Lab., NM.
SPACE SYSTEMS AND THE MILITARY GEOGRAPHY OF FUTURE REGIONAL CONFLICTS
R. L. Butterworth Jan. 1992 10 p
(Contract W-7405-eng-36)
(DE92-008174; LA-12252) Avail: NTIS HC/MF A02

The application of space systems to military operations as seen in Operation Desert Shield/Desert Storm will surely transform regional security environments around the world and rewrite the military geography of conflicts, alliances, and industrial strategies. The first part of this report outlines the significance of space systems for contemporary military operations, as seen recently in the operations against Iraq; the second part describes the likely response of other actors and regions; the third section discusses implications of these developments for the future military geography of regions important to American security; and the fourth highlights programmatic implications for future US capabilities. DOE

N92-24897*# Kansas State Univ., Manhattan. Biology Div.
THE INFLUENCE OF GRAZING ON SURFACE CLIMATOLOGICAL VARIABLES OF TALLGRASS PRAIRIE Final Technical Report
T. R. Seastedt, M. I. Dyer, and Clarence L. Turner 1992 212 p
(Grant NAG5-897)
(NASA-CR-190315; NAS 1.26:190315) Avail: NTIS HC/MF A10 CSCL 02C

Mass and energy exchange between most grassland canopies and the atmosphere are mediated by grazing activities. Ambient temperatures can be increased or decreased by grazers. Data have been assembled from simulated grazing experiments on Konza Prairie Research Natural Area and observations on adjacent pastures grazed by cattle show significant changes in primary production, nutrient content, and bidirectional reflectance characteristics as a function of grazing intensity. The purpose of this research was to provide algorithms that would allow incorporation of grazing effects into models of energy budgets using remote sensing procedures. The approach involved: (1) linking empirical measurements of plant biomass and grazing intensities to remotely sensed canopy reflectance, and (2) using a higher resolution, mechanistic grazing model to derive plant ecophysiological parameters that influence reflectance and other surface climatological variables. H.A.

N92-24976*# Nebraska Univ., Lincoln. Dept. of Agricultural Meteorology.
MEASUREMENT OF SURFACE PHYSICAL PROPERTIES AND RADIATION BALANCE FOR KUREX-91 STUDY Interim Report, 15 Sep. 1991 - 15 Mar. 1992
Elizabeth A. Walter-Shea, Blaine L. Blad, Mark A. Mesarch, and Cynthia J. Hays May 1992 33 p
(Grant NAG5-1762)
(NASA-CR-190288; NAS 1.26:190288; AgMet-92-2) Avail: NTIS HC/MF A03 CSCL 02C

Biophysical properties and radiation balance components were measured at the Streletskaya Steppe Reserve of the Russian Republic in July 1991. Steppe vegetation parameters characterized include leaf area index (LAI), leaf angle distribution, mean tilt angle, canopy height, leaf spectral properties, leaf water potential, fraction of absorbed photosynthetically active radiation (APAR), and incoming and outgoing shortwave and longwave radiation. Research results, biophysical parameters, radiation balance

estimates, and sun-view geometry effects on estimating APAR are discussed. Incoming and outgoing radiation streams are estimated using bidirectional spectral reflectances and bidirectional thermal emittances. Good agreement between measured and modeled estimates of the radiation balance were obtained.
Author

N92-24621# Centre National d'Etudes Spatiales, Aire-sur-l'Adour (France). Centre de Lancement de Ballons Stratospheriques.
ARCTIC CAMPAIGNS
Pierre Faucon *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 187-193 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24988*# Agricultural Research Service, Beltsville, MD. Product Utilization Div.
ADVANCED MANUFACTURING AND VALUE-ADDED PRODUCTS FROM US AGRICULTURE
Ruxton H. Villet, Dennis R. Child, and Basil Acock *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 13-19 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 02C

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N92-24669# Midwest Research Inst., Golden, CO.
APPLIED SCIENCES BRANCH Annual Report, FY 1990
B. M. Keyes, ed. and P. C. Dippo, ed. Nov. 1991 299 p
(Contract DE-AC02-83CH-10093)
(DE92-001201; NREL/TP-213-4461) Avail: NTIS HC/MF A13

The Applied Sciences Branch actively supports the advancement of DOE/SERI goals for the development and implementation of the solar photovoltaic technology. The primary focus of the laboratories is to provide state-of-the-art analytical capabilities for materials and device characterization and fabrication. The branch houses a comprehensive facility which is capable of providing information on the full range of photovoltaic components. A major objective of the branch is to aggressively pursue collaborative research with other government laboratories, universities, and industrial firms for the advancement of photovoltaic technologies. Members of the branch disseminate research findings to the technical community in publications and presentations. This report contains information on surface and interface analysis, materials characterization, development, electro-optical characterization module testing and performance, surface interactions and FTIR spectroscopy. DOE

N92-24670# Midwest Research Inst., Golden, CO.
PHOTOVOLTAIC ENERGY PROGRAM OVERVIEW, FISCAL YEAR 1991
Feb. 1992 27 p
(Contract DE-AC02-83CH-10093)
(DE92-001211; DOE/CH-10093/129) Avail: NTIS HC/MF A03

The Photovoltaics Program Plan, FY 1991 to FY 1995 builds on the accomplishments of the past 5 years and broadens the scope of program activities for the future. The previous plan emphasized materials and PV cell research. Under the balanced new plan, the PV Program continues its commitment to strategic research and development (R&D) into PV materials and processes, while also beginning work on PV systems and helping the PV industry encourage new markets for photovoltaics. A major challenge for the program is to assist the US PV industry in laying the foundation for at least 1000 MW of installed PV capacity in the United States and 500 MW internationally by 2000. As part of the new plan, the program expanded the scope of its activities in 1991. The PV Program is now addressing many new aspects of developing and commercializing photovoltaics. It is expanding activities with the US PV industry through the PV Manufacturing Technology (PVMaT) project, designed to address US manufacturers' immediate problems; providing technical assistance to potential end users such as electric utilities; and the program is turning its attention to encouraging new markets for PV. In 1991, for example, the PV Program initiated a new project with the PV industry to encourage a domestic market for PV applications in buildings and began cooperative ventures to support other countries such as Mexico to use PV in their rural electrification programs. This report reviews some of the development, fabrication and manufacturing advances in photovoltaics this year. DOE

N92-24679*# Texas A&M Univ., College Station.
MATHEMATICAL MODELING OF A THERMOVOLTAIC CELL
Ralph E. White and Makoto Kawanami 19 May 1992 61 p
(Grant NAG9-514)
(NASA-CR-189896; NAS 1.26:189896) Avail: NTIS HC/MF A04 CSCL 10A

A new type of battery named 'Vaporvolt' cell is in the early stage of its development. A mathematical model of a CuO/Cu 'Vaporvolt' cell is presented that can be used to predict the potential and the transport behavior of the cell during discharge. A sensitivity analysis of the various transport and electrokinetic parameters indicates which parameters have the most influence on the predicted energy and power density of the 'Vaporvolt' cell. This information can be used to decide which parameters should be optimized or determined more accurately through further modeling or experimental studies. The optimal thicknesses of electrodes and separator, the concentration of the electrolyte, and the current density are determined by maximizing the power density. These parameter sensitivities and optimal design parameter values will help in the development of a better CuO/Cu 'Vaporvolt' cell.
Author

N92-24686# Colorado State Univ., Fort Collins. Solar Energy Applications Lab.
DEVELOPING, TESTING, EVALUATING, AND OPTIMIZING SOLAR HEATING AND COOLING SYSTEMS
24 Jan. 1992 37 p
(Contract DE-FG03-86SF-16306)
(DE92-007148; DOE/SF-16306/32) Avail: NTIS HC/MF A03

The objective is to develop and test various integrated solar heating, cooling and domestic hot water systems, and to evaluate their performance. Systems composed of new, as well as previously tested, components are carefully integrated so that effects of new components on system performance can be clearly delineated. The SEAL-DOE program includes six tasks which have received funding for the 1991 to 92 fifteen-month period. These include: (1) a project employing isothermal operation of air and liquid solar space heating systems; (2) a project to build and test several generic solar water heaters; (3) a project that will evaluate advanced solar domestic hot water components and concepts and integrate them into solar domestic hot water systems; (4) a liquid desiccant cooling system development project; (5) a project that will perform system modeling and analysis work on solid desiccant cooling systems research; and (6) a management task. The objectives and progress in each task are described in this report. DOE

N92-24802*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SINTERLESS CONTACTS TO SHALLOW JUNCTION InP SOLAR CELLS
V. G. Weizer, N. S. Fatemi, and A. L. Korenyi-Both (Calspan Corp., Cleveland, OH.) 1992 7 p Presented at the Fourth International Conference on Indium Phosphide and Related Materials, Newport, RI, 21-24 Apr. 1992; sponsored by IEEE

(Contracts NAS3-25266; NAS3-30759)
(NASA-TM-105670; E-7036; NAS 1.15:105670) Avail: NTIS HC/MF A02 CSCL 10A

In the past, the achievement of good electrical contact to InP has inevitably been accompanied by mechanical degradation of the InP itself. Most contact systems require heat treatment after metal deposition that results in the dissolution of substantial amounts of InP into the metallization. Devices such as the solar cell, where shallow junctions are the rule, can be severely degraded if the damage to the semiconductor substrate is not precisely controlled. Two contact systems are described that provide low contact resistance to InP solar cells that do not require subjecting the current carrying metallization to a post deposition sintering process. It is shown that these two systems, one nickel based and the other silver based, provide contact resistivity values in the low 10(exp -6) ohm sq cm range, as fabricated, without the need for sintering. Author

N92-25049# Sandia National Labs., Albuquerque, NM.
FATIGUE LIFE VARIABILITY AND RELIABILITY ANALYSIS OF A WIND TURBINE BLADE
P. S. Veers, H. J. Sutherland, and T. D. Ashwill 1991 5 p Presented at the American Society of Civil Engineers (ASCE) Specialty Conference on Probabilistic Methods, Albuquerque, NM, 9-11 Jan. 1991
(Contract DE-AC04-76DP-00789)
(DE92-008673; SAND-91-0028C; CONF-9101134-1) Avail: NTIS HC/MF A01

Wind turbines must withstand harsh environments that induce many stress cycles into their components. A numerical analysis package is used to illustrate the sobering variability in predicted fatigue life with relatively small changes in inputs. The variability of the input parameters is modeled to obtain estimates of the fatigue reliability of the turbine blades. DOE

N92-25111# Midwest Research Inst., Golden, CO.
THIN EDGE-DEFINED FILM-FED GROWTH (EFG) OCTAGONS
J. P. Kalejs (Mobil Tyco Solar Energy Corp., Billerica, MA.) Mar. 1992 18 p
(Contract DE-AC02-83CH-10093)
(DE92-001167; NREL/TP-214-4484) Avail: NTIS HC/MF A03

Mobil Solar Energy Corp. investigated manufacturing crystalline silicon wafers using the edge-defined film-fed growth (EFG) technique. This report identifies the following: (1) current capabilities for manufacturing 200-micron-thick crystalline silicon wafers (10 cm x 10 cm) produced by growing octagons using the EFG technique and laser cutting them into wafers; (2) potential manufacturing improvements from decreasing the thickness of the wafers, improving the quality of the laser cut edge, and increasing cutting speed, all of which lead to reduce manufacturing costs, improved performance, and increased production capacities; (3) problems that impede achieving these potentials; and (4) costs and other requirements involved in overcoming the problems. DOE

N92-25143# Technische Univ., Delft (Netherlands).
STUDY OF ELECTROCHEMICAL PROCESSES AND WETTING PHENOMENA AT THE MOLTEN CARBONATE FUEL CELL ANODE Ph.D. Thesis
Ricardo Weewer 1991 221 p Sponsored by Netherlands Agency for Energy and the Environment
(Contract ECN-4-903-01/02)
(ISBN-90-900-4381-0; ETN-92-91297) Avail: NTIS HC/MF A10

A study to ellucidate the mechanism and kinetics of the hydrogen oxidation reaction in various molten carbonate compositions and at different candidate electrode materials is presented. Experimental conditions and electrochemical methods were investigated in order to obtain more basic knowledge of the molten carbonate anode system. The described experiments have a strongly exploratory character, and most of the experiments were conducted at gold electrodes. A critical analysis of the possibilities offered by four electrochemical techniques for the elucidation of the hydrogen oxidation reaction is given. To facilitate the elucidation of the hydrogen oxidation mechanism, the experimental problems accompanying research in molten carbonates are described along with possible solutions. In order to make up arrears regarding fundamental aspects of the anodic fuel cell reaction, an extensive discussion on molten carbonate chemistry, proposed mechanisms, electrochemical techniques, and porous electrodes is given. Experiments performed at solid electrodes on the so called 'pot cell' or 'half cell', comprising polarization measurements, cyclic voltammetry, chrono-amperometry, and impedance measurements at gold, nickel, copper flag electrodes in Li/K carbonate, are described. Impedance measurements carried out at aporous Ni/Cr anode in a symmetric laboratory are described. Wetting experiments carried out using the sessile drop method are described. ESA

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N92-24256# State Univ. of New York, Stony Brook.
FIRST YEAR PROGRESS REPORT ON RESEARCH PROJECT ON CO2-INDUCED CLIMATE CHANGE
R. D. Cess and S. Hameed 1991 6 p
(Contract DE-FG02-85ER-60314)
(DE92-007589; DOE/ER-60314/4) Avail: NTIS HC/MF A02

The three major areas of study are discussed separately in this report of the first year of the Research Project on CO2 Induced Climate Change. The first task deals with an intercomparison of general circulation model capabilities with the aim of improving their parameterizations of important physical processes, so that model predictions of CO2 induced climate change become more reliable. The second task encompasses analysis of climate data for the purpose of understanding climate change and climate variability. The third task is concerned with analyzing climatic variability in General Circulation Models and its comparison with observations. DOE

N92-24288# Alliance Technologies Corp., Chapel Hill, NC.
GREENHOUSE GASES FROM SMALL-SCALE COMBUSTION IN DEVELOPING COUNTRIES: A PILOT STUDY IN MANILA Final Report, Jun. 1990 - Sep. 1991
Kirk R. Smith, R. A. Rasmussen, Ferdinand Manegdeg, and Michael Apte (California Univ., Berkeley. Lawrence Berkeley Lab.) Jan. 1992 75 p
(Contract EPA-68-D9-0173)
(PB92-139369; EPA/600/R-92/005) Avail: NTIS HC/MF A04 CSCL 13B

Results are given of sampling of combustion gases released by household cookstoves in Manila. In a total of 24 samples, 14 cookstoves were tested, fueled by liquefied petroleum gas (LPG), kerosene (three kinds of stoves), charcoal and wood. Five ambient samples were analyzed for carbon dioxide (CO2), carbon monoxide (CO), methane (CH4), nitrous oxide (N2O), total nonmethane organic compounds (TNMOCs), total alkanes, total alkenes, terpenes, total nonmethane hydrocarbons (NMHCs), 88 individual hydrocarbons, total unidentified hydrocarbons, three chlorofluorocarbons (CFCs), and five other halocarbons. Results generally confirm increasing emissions for nearly every measured contaminant of fuels, moving down the energy ladder from gaseous to liquid to processed solid to unprocessed solid. The detailed speciation provided can potentially assist in predicting health risks from such emissions. Although the sample size was far too small to give much confidence in the results, extrapolation of the emission ratios (each gas relative to CO2) to global estimates indicates that published global inventories of several gases important to atmospheric chemistry may be somewhat too small for the fuelwood combustion category. Author

N92-24550# Argonne National Lab., IL.
TO MITIGATE OR NOT TO MITIGATE: REGULATORY TREATMENT OF EMISSIONS TRADING AND ITS EFFECT ON MARKETPLACE INCENTIVES
K. A. McDermott (Illinois State Univ., Normal.) and D. W. South 1991 16 p Presented at the 84th Annual Meeting and Exhibition of the Air and Waste Management Association, Vancouver, British Columbia, 16-21 Jun. 1991
(Contract W-31-109-eng-38)
(DE92-009708; ANL/CP-72022; CONF-910659-35) Avail: NTIS HC/MF A03

The Clean Air Act Amendments (CAAA) of 1990 have created a market-based mechanism that is designed to employ a profit-oriented incentive to enable electric utilities to reduce SO2 emissions at the least cost. One of the most important challenges facing state regulatory utility commissions in the next decade is the integration of this marker-based profit-incentive process into the traditional rate-base, rate-of-return, profit-control approach to regulation. How the struggle to meld two potentially contradictory control and incentive programs will be resolved remains to be seen. As of now, it is an open question. The purpose of this paper is to help clarify some of the issues that need to be addressed and to offer some policy recommendations that will allow regulators to employ the effectiveness of market forces while they still retain overall control of the evolution of the regulated electric supply market. DOE

N92-24569# Radian Corp., Austin, TX.
FUNDAMENTAL INVESTIGATION OF DUCT/ESP PHENOMENA
Charles A. Brown, Michael D. Durham, William A. Sowa (California Univ., Irvine.), Richard M. Himes, and William A. Mahaffey 21 Oct. 1991 124 p
(Contract DE-AC22-88PC-88850)
(DE92-008470; DOE/PC-88850/T6) Avail: NTIS HC/MF A06

Radian Corporation was contracted to investigate duct injection and ESP phenomena in a 1.7 MW pilot plant constructed for this test program. This study was an attempt to resolve problems found in previous studies and answer remaining questions for the technology using an approach which concentrates on the fundamental mechanisms of the process. The goal of the study was to obtain a better understanding of the basic physical and chemical phenomena that control: (1) the desulfurization of flue gas by calcium-based reagent; and (2) the coupling of an existing ESP particulate collection device to the duct injection process. DOE

N92-24572# Mitre Corp., McLean, VA. JASON Program Office.
STATISTICS OF EXTREME EVENTS WITH APPLICATION TO CLIMATE
H. Abarbanel, S. Koonin, H. Levine, G. MacDonald, and O. Rothaus 10 Jan. 1992 79 p
(Contract DE-AI05-90ER-30174)
(DE92-008515; JSR-90-305) Avail: NTIS HC/MF A05

The statistical theory of extreme events is applied to observed global average temperature records and to simplified models of climate. Both hands of records exhibit behavior in the tails of the distribution that would be expected from a random variable having a normal distribution. A simple nonlinear model of climate due to Lorenz is used to demonstrate that the physical dimensions of the underlying attractor, determined by applicable conservation laws, limits the range of extremes. These limits are not reached in either observed series or in more complex models of climate. The effect of a shift in mean on the frequency of extremes is discussed with special reference to possible thresholds for damage to climate variability. DOE

N92-24580# Oak Ridge National Lab., TN.
EXPLANATORY MODELS FOR ECOLOGICAL RESPONSE SURFACES
H. I. Jager and W. S. Overton (Oregon State Univ., Corvallis.) 1991 17 p Presented at the Conference on Integrating Geographic Information and Environmental Modeling, Boulder, CO, 15-19 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE92-007840; CONF-9109345-1) Avail: NTIS HC/MF A03

Understanding the spatial organization of ecological systems is a fundamental part of ecosystem study. While discovering the causal relationships of this organization is an important goal, our purpose of spatial description on a regional scale is best met by use of explanatory variables that are somewhat removed from the mechanistic causal level. Regional level understanding is best obtained from explanatory variables that reflect spatial gradients at the regional scale and from categorical variables that describe the discrete constituents of (statistical) populations, such as lakes. In this paper, we use a regression model to predict lake acid neutralizing capacity (ANC) based on environmental predictor variables over a large region. These predictions are used to produce model-based population estimates. Two key features of our modeling approach are that it honors the spatial context and the design of the sample data. The spatial context of the data are brought into the analysis of model residuals through the interpretation of residual maps and semivariograms. The sampling design is taken into account by including stratification variables from the design in the model. This ensures that the model applies to a real population of lakes (the target population), rather than whatever hypothetical population the sample is a random sample of. DOE

N92-24671# Laser Applications Research Center, The Woodlands, TX.
THE 1991 WOODLANDS CONFERENCE: THE REGIONS AND GLOBAL WARMING: IMPACTS AND RESPONSE STRATEGIES
1991 24 p Conference held in Woodlands, TX, 3-6 Mar. 1991
(Contract DE-AC05-84OR-21400)
(DE92-003221; CONF-9103221-Summ) Avail: NTIS HC/MF A03

To date, much of the attention given to global warming in scientific research as well as in policy development has focused on the global picture. International negotiations and agreements to stabilize, and eventually reduce, greenhouse gas emissions are very important. By themselves, however, they are not sufficient to address global warming. Regional strategies are also needed. They can help reduce greenhouse gas emissions, and they will be the most effective way to mitigate the consequences of global warming. Adaptive strategies must respond to local and regional conditions. In many countries, subnational jurisdictions such as states and provinces or community organizations can already take effective actions without direction from their national government or waiting for international agreements. An important factor in defining regional approaches is the disparate consequences of climate change for developed and developing areas. Different strategies will also be needed for industrial and agricultural regions. Wealthy industrial regions may be better able to develop capital-intensive, adaptive infrastructure than regions with fewer discretionary resources where people are more vulnerable to the vagaries of weather patterns. On the other hand, regions that rely on indigenous knowledge and local resources may be better equipped to make incremental adaptations and more willing to modify life-styles. Ultimately, all climate change effects are experienced in specific places and effective response depends upon local action. We recognize that individual localities cannot solve a problem of global proportions by acting alone. However, a regional strategy can supplement international and national action and be the focal point for addressing risks in the unique social and economic context of a particular area. These meetings discussions dealt with the impacts and implications of climate change on such things as agriculture, forestry, and policy. DOE

N92-24712# Westinghouse Savannah River Co., Aiken, SC.
THREE DIMENSIONAL DIGITAL IMAGING OF ENVIRONMENTAL DATA
R. L. Nichols and C. A. Eddy 14 Jun. 1991 17 p
(Contract DE-AC09-89SR-18035)
(DE92-009790; WSRC-RD-91-14) Avail: NTIS HC/MF A03

The Environmental Sciences Section (ESS) of the Savannah

River Laboratory has recently acquired the computer hardware (Silicon Graphics Personal Iris Workstations) and software (Dynamic Graphics, Interactive Surface and Volume Modeling) to perform three dimensional analysis of hydrogeologic data. Three dimensional digital imaging of environmental data is a powerful technique that can be used to incorporate field, analytical, and modeling results from geologic, hydrologic, ecologic, and chemical studies into a comprehensive model for visualization and interpretation. This report covers the contamination of four different sites of the Savannah River Plant. Each section of this report has a computer graphic display of the concentration of contamination in the groundwater and/or sediments of each site. DOE

N92-24878# Oak Ridge National Lab., TN.
WHAT CAUSED THE GLACIAL TO INTERGLACIAL CO2 CHANGE?
Wallace S. Broecker (Lamont-Doherty Geological Observatory, Palisades, NY.) and Tsung-Hung Peng Dec. 1991 23 p Presented at the 2nd Ciocco Global Cycle Meeting, Ciocco (Italy), 8-20 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE92-007247; CONF-9109340-1) Avail: NTIS HC/MF A03

Scenarios put forward to explain the 80 micro-atm glacial to interglacial change in atmospheric CO2 content are evaluated. The conclusion is that no single mechanism is adequate. Rather, contributions from temperature, sea ice, biologic pumping, nutrient deepening, and CaCO3 cycling must be called upon. The observation that the C-13/C-12 ratio for Antarctic foraminifera was 0.9 +/- 0.1 percent lower during glacial than during interglacial time constitutes a huge fly in the ointment for all scenarios proposed to date. DOE

N92-24904# Corvallis Environmental Research Lab., OR.
GLOBAL CARBON CYCLE AND CLIMATE CHANGE: BOOK CHAPTER
R. K. Dixon 1992 11 p Submitted for publication
(PB92-153741; EPA/600/A-92/048) Avail: NTIS HC/MF A03
CSCL 13B

The production of greenhouse gases due to anthropogenic activities may have begun to change the global climate. The global carbon cycle plays a significant role in projected climate change. However, considerable uncertainty exists regarding pools and flux in the global cycle. Given the author's present understanding of current global carbon sources and sinks, feedbacks from the biosphere are likely to influence the process of climate change. Opportunities may exist to manage the biosphere and reduce the accumulation of greenhouse gases in the atmosphere. The role of the global carbon cycle in projected climate change is surveyed. Author

N92-24965# Alliance Technologies Corp., Lowell, MA.
SEASONAL AND ANNUAL BIOGENIC EMISSION INVENTORIES FOR THE US AND CANADA Report, Jun. - Sep. 1991
L. G. Modica and C. D. Geron 1992 15 p Presented at the Air and Waste Management Association Specialty Conference, Durham, NC, 9-12 Sep. 1991
(Contract EPA-68-D9-0173)
(PB92-139427; EPA/600/A-92/005) Avail: NTIS HC/MF A03
CSCL 13B

The paper summarizes methods and results used to develop an emissions inventory for the U.S. and Canada. The inventory was used to assess the role of biogenic emissions in ozone formation. Emission inventories were developed at hourly and grid (1/4 x 1/6 degree) levels from input data at the same scales. Resultant emissions were aggregated temporally (to monthly, seasonal, and annual levels) and spatially (to county and state levels). The summary indicates that 53 percent of annual total biogenic hydrocarbon emissions occur during the summer, but only 4 percent in the winter. Results are also compared with biogenic emission estimates generated by other researchers, and attempts are made to identify possible causes of observed differences. Recommendations for improvement and further research are discussed. Results of the study will be useful to air quality planners and scientists involved in biological and trace gas research. Historically, ozone control programs based on reductions of known anthropogenic volatile organic compound (VOC) emissions have had limited success in attaining the National Ambient Air Quality Standard. Therefore, researchers are evaluating VOC emission sources not routinely considered in ozone control strategies. One potentially large source of reactive VOCs is emissions from crop and forest foliage. GRA

N92-25023# Pacific Environmental Services, Inc., Durham, NC.
BURNING TIRES FOR FUEL AND TIRE PYROLYSIS: AIR IMPLICATIONS
C. Clark, K. Meardon, and D. Russell Dec. 1991 234 p
(Contract EPA-68-D-00124)
(PB92-145358; EPA/450/3-91/024) Avail: NTIS HC/MF A11
CSCL 13B

This document was developed in response to increasing inquiries into the environmental impact of burning waste tires in process equipment. The document provides information on the use of whole, scrap tires and tire-derived fuel (TDF) as combustion fuel and on the pyrolysis of scrap tires. The use of whole tires and TDF as a primary fuel is discussed for dedicated tire-to-energy facilities. The use of whole tires and TDF as a supplemental fuel is discussed for cement manufacturing plants, electric utilities, pulp and paper mills, and other industrial processes. The focus of the document is on the impact of burning whole tires and TDF on air emissions. Test data are presented and, in most instances, compared with emissions under baseline conditions (no tires or TDF in the fuel). The control devices used in these industries are discussed and, where possible, their effectiveness in controlling emissions from the burning of whole tires or TDF is described. In addition, the report provides information on the processes themselves that use whole tires or TDF, the modifications to the processes that allowed the use of whole tires or TDF, and the operational experiences of several facilities using whole tires or TDF. The economic feasibility of using whole tires and TDF for the surveyed industries is discussed. Finally, contacts for state waste tire programs are presented. GRA

N92-25062# Department of Energy, Washington, DC.
CLIMATE CHANGE AND RELATED ACTIVITIES
1992 17 p
(DE92-008012; DOE/PE-0102P) Avail: NTIS HC/MF A03

The 'greenhouse' process regulates the Earth's climate at a level to sustain life, making our planet unique. The term 'climate' refers not only to temperature, but also to the entire system of precipitation, cloudiness, and winds, as well as to the distribution of these features in space and time. The production and consumption of energy contributes to the concentration of greenhouse gases in the atmosphere and is the focus of other environmental concerns as well. Yet the use of energy contributes to worldwide economic growth and development. If we are to achieve sound environmental economic growth, we must develop and deploy energy technologies that contribute to global stewardship. Global climate change is a significant issue for the U.S. Department of Energy (DOE) because greenhouse gases are emitted from the production and use of fossil fuels. Energy use and production now contribute more than half of the total manmade emissions on a global basis. DOE carries out an aggressive scientific research program to address some of the key uncertainties associated with the climate change issue. Of course, research simply to study the science of global climate change is not enough. At the heart of any regime of cost effective actions to address the possibility of global climate change will be a panoply of new technologies; technologies both to provide the services we demand and to use energy more efficiently than in the past. These, too, are important areas of responsibility for DOE. This report is a brief description of DOE's activities in scientific research, technology development, policy studies, and international cooperation that are directly related to or have some bearing on the issue of global climate change. DOE

N92-25118# Mitre Corp., McLean, VA. Jason Program Office.
ISSUES IN PREDICTABILITY
H. Abarbanel, S. Koonin, H. Levine, G. MacDonald, and O. Rothaus Dec. 1991 58 p
(Contract DE-AI05-90ER-30174)
(DE92-008514; JSR-90-320) Avail: NTIS HC/MF A04

Since the beginning of the greenhouse debate, policy makers have demanded from the scientific community predictions of future climate in limited geographical areas (e.g., Congressional Districts) and limited time intervals (e.g., Convention Time, 2000). Current climate models clearly do not have such capabilities, as is demonstrated by large disagreements among the models of continental size regions. Government and private groups have proposed programs such as DOE's CHAMMP and UCAR's CSMP to remedy the situation. Largely lost in the debate are fundamental questions such as: What is meant by predictability; What can be predicted and over what time and length scale; What errors can be expected from predictions. This report explores some of the issues by analyzing toy models of climate and existing data sets of global annual average surface air temperature. DOE

N92-24354# Muenster Univ. (Germany, F.R.). Abt. Landschaftsoekologie.
DEVELOPMENT OF A PC-AIDED IMAGE PROCESSING SYSTEM FOR ENVIRONMENT MANAGEMENT [ENTWICKLUNG EINES PC-GESTUETZTEN BILDVERARBEITUNGSSYSTEMS FUER DIE UMWELTPLANUNG]
U. Streit, S. Bender, P. Kempa, and K. Wiesmann *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 19-20 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24997*# Environmental Protection Agency, Cincinnati, OH. Risk Reduction Engineering Lab.
INTELLIGENT PROCESSING EQUIPMENT WITHIN THE ENVIRONMENTAL PROTECTION AGENCY
Daniel G. Greathouse and Richard P. Nalesnik (Environmental Protection Agency, Washington, DC.) *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 95-101 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13B

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N92-24236*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
CRUSTAL DYNAMICS PROJECT DATA ANALYSIS, 1991: VLBI GEODETIC RESULTS, 1979 - 1990
C. Ma, J. W. Ryan, and D. S. Caprette (Hughes STX, Inc., Lanham, MD.) Mar. 1992 402 p
(NASA-TM-104552; Rept-92B00070; NAS 1.15:104552) Avail: NTIS HC/MF A18 CSCL 08G

The Goddard VLBI group reports the results of analyzing 1412 Mark II data sets acquired from fixed and mobile observing sites through the end of 1990 and available to the Crustal Dynamics Project. Three large solutions were used to obtain Earth rotation parameters, nutation offsets, global source positions, site velocities, and baseline evolution. Site positions are tabulated on a yearly basis from 1979 through 1992. Site velocities are presented in both geocentric Cartesian coordinates and topocentric coordinates. Baseline evolution is plotted for 175 baselines. Rates are computed for earth rotation and nutation parameters. Included are 104 sources, 88 fixed stations and mobile sites, and 688 baselines. Author

N92-24666*# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
IMPROVEMENT OF THE EARTH'S GRAVITY FIELD FROM TERRESTRIAL AND SATELLITE DATA Final Technical Report, 1 Jun. 1990 - 31 Dec. 1991
Richard H. Rapp Mar. 1992 9 p
(Grant NAG5-1329)
(NASA-CR-190236; NAS 1.26:190236) Avail: NTIS HC/MF A02 CSCL 08G

The determination of the Earth's gravitational potential can be done through the analysis of satellite perturbations, the analysis of surface gravity data, or both. The combination of the two data types yields a solution that combines the strength of each method: the longer wavelength strength in the satellite analysis with the better high frequency information from surface gravity data. Since 1972, Ohio State has carried out activities that have provided surface gravity data to a number of organizations who have developed combination potential coefficient models that describe the Earth's gravitational potential. D.R.D.

N92-24667*# Midwest Research Inst., Kansas City, MO. Chemical Sciences Dept.
A MOLECULAR BEAM MASS SPECTROMETRIC STUDY OF THE FORMATION AND PHOTOLYSIS OF C(LC)LO DIMER Final Report
Frank T. Greene and David A. Robaugh 6 Mar. 1992 77 p
(Contract NASw-4371; MRI Proj. 9316/17/18-A)
(NASA-CR-190259; NAS 1.26:190259; MRI-A/R9316.FR) Avail: NTIS HC/MF A05 CSCL 04A

A study of the chlorine oxides present at temperatures and pressures typical of the Antarctic stratosphere was carried out. A series of low temperature flow reactors was constructed and used in conjunction with molecular beam mass spectrometric techniques to identify species and characterize their kinetic behavior at temperatures of -20 to -70 C and pressures of from 30 to 130 Torr. It was found that the gas phase chlorine-oxygen system was quite complex at low temperatures. ClO dimer was identified and found to be thermodynamically very stable under stratospheric conditions. It was also found that any system which contained ClO also contained a larger oxide. The oxide was identified as Cl2O3. A survey of possible higher oxides, which have been postulated as possible chlorine sinks in the stratosphere, was also carried out. The rate of formation of ClO dimer was measured as a function of temperature and pressure. Measurements were made of both the decay of ClO and the formation of the dimer. By comparing these rates it was determined that virtually all of the ClO was converted to the dimer under stratospheric conditions, and that the other ClO reactions were not important under these conditions. Author

N92-24690# Los Alamos National Lab., NM.
RECURRENCE MODELS OF VOLCANIC EVENTS: APPLICATIONS TO VOLCANIC RISK ASSESSMENT
B. M. Crowe, R. Picard, G. Valentine, and F. V. Perry (New Mexico Univ., Albuquerque.) 1992 13 p Presented at the International High Level Radioactive Waste Management Conference: Promoting Understanding Through Education and Communication, Las Vegas, NV, 12-16 Apr. 1992
(Contract W-7405-eng-36)
(DE92-008443; LA-UR-92-377; CONF-920430-64) Avail: NTIS HC/MF A03

An assessment of the risk of future volcanism has been conducted for isolation of high level radioactive waste at the potential Yucca Mountain site in southern Nevada. Risk used in this context refers to a combined assessment of the probability and consequences of future volcanic activity. Past studies established bounds on the probability of magmatic disruption of a repository. These bounds were revised as additional data were gathered from site characterization studies. The probability of direct intersection of a potential repository located in an eight sq km

area of Yucca Mountain by ascending basalt magma was bounded by the range of 10(exp -8) to 10(exp -10)/yr. The consequences of magmatic disruption of a repository were estimated in previous studies to be limited. The exact releases from such an event are dependent on the strike of an intruding basalt dike relative to the repository geometry, the timing of the basaltic event relative to the age of the radioactive waste and the mechanisms of release and dispersal of the waste radionuclides in the accessible environment. The combined low probability of repository disruption and the limited releases associated with this event established the basis for the judgement that the risk of future volcanism was relatively low. It was reasoned that risk of future volcanism was not likely to result in disqualification of the potential Yucca Mountain site. DOE

N92-24697# Los Alamos National Lab., NM.
MICROSEISMIC MONITORING AS A TOOL FOR MAPPING FRACTURES IN THE SAN ANDRES DOLOMITE
J. T. Rutledge, T. D. Fairbanks, L. S. House, and M. B. Murphy (Murphy Operating Corp., Roswell, NM.) 1991 9 p Presented at the Oklahoma Geologic Survey on Petroleum Reservoirs in the Southern Midcontinent, Norman, OK, 26-27 Mar. 1991
(Contract W-7405-eng-36)
(DE92-007436; LA-UR-92-195; CONF-9103222-1) Avail: NTIS HC/MF A02

Microseismic monitoring shows promise of being a practical tool for mapping fractures in the San Andres dolomite in terms of rate of microearthquake occurrence and the areal coverage possible from a single downhole seismometer. Microearthquakes were detected during normal waterflood production but monitoring was not complete enough to correlate injection/production activity with microseismic event recurrence. Constant monitoring time capability with at least 3 downhole seismometers is needed to more accurately locate events, and to reliably characterize seismic recurrence in the field. In addition, modeling pressure variations in the reservoir may help explain the mechanisms that produces the microearthquakes. Data useful in modeling the pressure variations could be from tracer experiments, pressure interference tests and individual well production-injection volume. Understanding the mechanism of producing the microearthquakes should, in turn, allow the correlation of the microseismicity with fluid flow within the reservoir. DOE

N92-24714# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SPATIAL AND TEMPORAL VARIABILITY OF THE ATMOSPHERIC COMPONENTS OF THE HYDROLOGICAL CYCLE OF THE AMAZON REGION DURING THE GTE/ABLE-2B Thesis
Paulo Fernando deSou Souza Jun. 1991 101 p In PORTUGUESE; ENGLISH summary
(INPE-5281-TDI/451) Avail: NTIS HC/MF A06

Spatial and temporal variability of atmospheric components of the hydrological cycle of the Amazon Region during the Global Tropospheric Experiment/Amazon Boundary Layer Experiment (GTE/ABLE IIB) are studied using rainfall and radiosonde data. Analysis of the water vapor content (PW) in the region shows pronounced spatial variability. High areas of PW are found in the central north and western Amazon Basin, while in the southeastern sector the PW values are relatively low. The diurnal cycle of PW is small; the maximum amplitude is smaller than 10 percent compared with the mean. The pronounced daily variability reflects the passage of weather systems in the region. The vertically integrated water vapor flux is dominated by westward flow from the Equatorial Atlantic Ocean. Daily fluctuations of this flux is also modulated by passage of weather systems in the region. Results of evaluating divergence of water vapor flux reveal that convergence prevails in the basin during that time period. Geographically, in the northern sector of Amazon, local evapotranspiration is the main source of moisture for precipitation process, while in the southern sector convergence of water vapor is dominant. Total evatranspiration over the Amazon Basin, estimated as a residual of the water vapor balance equation is 108.7 mm. Author

N92-24968# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
A CUMULUS PARAMETERIZATION SCHEME DESIGNED FOR NESTED GRID MESO-(BETA) SCALE MODELS
M. J. Weissbluth and W. R. Cotton 1991 4 p Presented at the 9th Conference on Numerical Weather Prediction, Denver, CO, 14-18 Oct. 1991
(Contract DE-FG02-90ER-61066)
(DE92-007206; DOE/ER-61066/2; CONF-9110325-1) Avail: NTIS HC/MF A01

A generalized cumulus parameterization based upon higher order turbulence closure was incorporated into one-dimensional simulations. The scheme consists of a level 2.5w turbulence closure scheme mated with a convective adjustment scheme. The convective adjustment scheme includes a gradient term which is interpreted as either a subsidence term when the scheme is used in large scale models or a mesoscale compensation term when the scheme is used in mesoscale models. The scheme also includes a convective adjustment term which is interpreted as a detrainment term in large scale models. In mesoscale models, the mesoscale compensation term and the advection by the mean vertical motions combine to yield no net advection which is desirable since the convective moistening and heating is now wholly accomplished by the convective adjustment term; double counting is then explicitly eliminated. One dimensional simulations indicate satisfactory performance of the cumulus parameterization scheme for a non-entraining updraft. DOE

N92-24372# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
ATMOSPHERE AND SPACE RESEARCH AT THE INSTITUTE OF PHYSICS, BONN UNIVERSITY (GERMANY, F.R.) [ATMOSPHAEREN- UND WELTRAUMFORSCHUNG AM PHYSIKALISCHEN INSTITUT DER UNIVERSITAET BONN]
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 63 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24375# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
RESEARCH FIELD 2: INVESTIGATIONS OF THE MIDDLE EARTH ATMOSPHERE USING HIGH ALTITUDE RESEARCH ROCKETS. PROJECT 2.1: THE PROJECTS MAC/SINE AND MAC/EPSILON [ARBEITSBEREICH 2. UNTERSUCHUNGEN DER MITTLEREN ATMOSPHAERE DER ERDE MITTELS HOEHENFORSCHUNGSRAKETEN. PROJEKT 2.1: DIE PROJEKTE MAC/SINE UND MAC/EPSILON]
H. Baumann, W. Hillert, F.-J. Luebken, W. Meyer, R. Siebenmorgen, and U. vonZahn *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 69 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24376# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
RESEARCH FIELD 2: INVESTIGATIONS OF THE MIDDLE EARTH ATMOSPHERE USING HIGH ALTITUDE RESEARCH ROCKETS. PROJECT 2.2: ROSE. PROJECT 2.3: TURBO [ARBEITSBEREICH 2: UNTERSUCHUNGEN DER MITTLEREN ATMOSPHAERE DER ERDE MITTELS HOEHENFORSCHUNGSRAKETEN. PROJEKT 2.2: DAS PROJEKT ROSE. PROJEKT 2.3: DAS PROJEKT TURBO]
A. Friker, F.-J. Luebken, U. vonZahn, H. Baumann, W. Hillert, and G. Lehmacher *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A

Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 70 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24377# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
RESEARCH FIELD 2: INVESTIGATIONS OF THE MIDDLE EARTH ATMOSPHERE USING HIGH ALTITUDE RESEARCH ROCKETS. PROJECT 2.4: MASERATI [ARRBEITSBEREICH 2. UNTERSUCHUNGEN DER MITTLEREN ATMOSPHAERE DER ERDE MITTELS HOEHENFORSCHUNGSRAKETEN. PROJEKT 2.4: DAS PROJEKT MASERATI]
F.-J. Luebken and D. Rebscher *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 71 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24378# Bonn Univ. (Germany, F.R.).
RESEARCH FIELD 3: INVESTIGATIONS OF THE MIDDLE EARTH ATMOSPHERE WITH LASERS. PROJECT 3.1: TEMPERATURES AT HEIGHTS BETWEEN 80 AND 100 km [ARBEITSBEREICH 3: UNTERSUCHUNGEN DER MITTLEREN ATMOSPHAERE DER ERDE MITTLES LASER. PROJEKT 3.1: TEMPERATUREN IM HOEHENBEREICH 80 BIS 110 KM]
M. Alpers, K. H. Fricke, P. vonderGathen, G. Hansen, H. Kurzawa, M. Serwazi, C. Tilgner, and U. vonZahn *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 72 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24379# Bonn Univ. (Germany, F.R.).
RESEARCH FIELD 3: INVESTIGATIONS OF THE MIDDLE EARTH ATMOSPHERE WITH LASERS. PROJECT 3.2: INVESTIGATION OF IRON DENSITIES. PROJECT 3.3: MEASUREMENTS OF THE TEMPERATURE OF THE POLAR STRATOSPHERE [ARBEITSBEREICH 3: UNTERSUCHUNGEN DER MITTLEREN ATMOSPHAERE DER ERDE MITTELS LASER. PROJEKT 3.2: UNTERSUCHUNG VON EISENSCHICHTEN. PROJEKT 3.3: MESSUNGEN DER TEMPERATUR DER POLAREN STRATOSPHAERE]
M. Alpers, J. Hoeffner, U. vonZahn, K. H. Fricke, J. Schaefer, and P. Scheuch *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 73 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24595# Centre de Recherches en Physique de l'Environnement, Saint Maur des Fosses (France).
WAVE-PARTICLE INTERACTIONS IN THE HIGH-LATITUDE MAGNETOSPHERE
R. Pottelette, N. Dubouloz, and R. Treumann (Max-Planck-Inst. fuer Physik und Astrophysik, Garching, Germany, F.R.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 37-40 (For primary document see N92-24589 15-12)
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N92-24597# Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
MAGNETIC DISTURBANCES MEASURED ON-BOARD BALLOON IN AURORAL ZONES: PRINCIPLES AND METHODS
J. P. Ducarteron, J. P. Treilhou, J. Coutelier, J. L. Medale, J. Crasnier, and F. Olivie *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 45-47 Prepared in cooperation with Centre National de la Recherche Scientifique, Toulouse, France and Toulouse Univ., France (For primary document see N92-24589 15-12)
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N92-24598# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (Germany, F.R.).
EUROPEAN RIOMETER OBSERVATION SYSTEM
E. Nielsen, C. H. Barrow, J. K. Hargreaves, A. Ranta, H. Ranta, P. Stauning, and A. N. Zaitzev (Academy of Sciences, USSR, Moscow) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 49-53 (For primary document see N92-24589 15-12)
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N92-24599# Norwegian Defence Research Establishment, Kjeller.
THE 20 YEARS WITH ELECTRON BEAM EXPERIMENTS ON ROCKETS AND SATELLITES
Bernt N. Maehlum *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 55-61 (For primary document see N92-24589 15-12)
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N92-24600# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
ACTIVE IONOSPHERIC EXPERIMENTS ON ALFVEN'S CIV EFFECT
Nils Brenning *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 63-67 Sponsored by Swedish Natural Science Research Council (For primary document see N92-24589 15-12)
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N92-24603*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
NLC-91
E. Kopp, G. Witt (Stockholm Univ., Sweden), and R. A. Goldberg *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 85-92 (For primary document see N92-24589 15-12)
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N92-24604# Norwegian Defence Research Establishment, Kjeller.
ROCKET FOR OPTICAL STUDIES OF THE NEUTRAL ATMOSPHERE BY LASER DETECTION (RONALD)
U.-P. Hoppe, E. V. Thrane, T. A. Blix, and T. Eriksen *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 93-98 (For primary document see N92-24589 15-12)
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N92-24605# Bonn Univ. (Germany, F.R.). Inst. fuer Physik.
MASERATI: A NEW ROCKETBORNE TUNABLE DIODE LASER EXPERIMENT TO MEASURE TRACE GASES IN THE MIDDLE ATMOSPHERE
F.-J. Luebken *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 99-104 (For primary document see N92-24589 15-12)
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N92-24606# EISCAT Scientific Association, Kiruna (Sweden).
APPLICATION OF THE EISCAT RADARS TO MIDDLE ATMOSPHERE RESEARCH
P. N. Collis *In* ESA, 10th ESA Symposium on European Rocket

and Balloon Programmes and Related Research Nov. 1991 p 105-109 (For primary document see N92-24589 15-12)
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N92-24607# Bonn Univ. (Germany, F.R.). Inst. fuer Physik.
IRON ATOM DENSITIES IN THE POLAR MESOSPHERE
M. Alpers and U. vonZahn *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 111-114 (For primary document see N92-24589 15-12)
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N92-24609# Tromsoe Univ. (Norway). Inst. of Mathematical and Physical Sciences.
ATTRACTOR DIMENSIONALITY FOR MESOSPHERIC TURBULENCE
C. Hall, E. V. Thrane, and T. A. Blix (Norwegian Defence Research Establishment, Kjeller.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 121-125 (For primary document see N92-24589 15-12)
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N92-24610# Stockholm Univ. (Sweden). Dept. of Meteorology.
THE EXCITATION OF THE CHAMBERLAIN AND HERZBERG 2 BANDS IN THE TERRESTRIAL NIGHTGLOW
D. P. Murtagh, J. Stegman, and G. Witt *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 127-130 (For primary document see N92-24589 15-12)
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N92-24611# Canadian Space Agency, Ottawa (Ontario).
PROJECT GEMINI: GENERAL EXCITATION MECHANISMS IN NIGHTGLOW
J. G. Rumbold and F. R. Harris (Herzberg Inst. of Astrophysics, Ottawa, Ontario) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 131-136 (For primary document see N92-24589 15-12)
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N92-24619# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
IN-SITU BALLOON MEASUREMENT OF LOCAL STRATOSPHERIC DYNAMICS CHARACTERISTICS
J. Barat and C. Cot *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 175-178 (For primary document see N92-24589 15-12)
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N92-24620# Centre National de la Recherche Scientifique, Paris (France). Lab. de Physique Moleculaire et Applications.
BALLOON-BORNE SOLAR OCCULTATION FOURIER TRANSFORM SPECTROMETRY FOR MEASUREMENTS OF STRATOSPHERIC TRACE SPECIES
C. Camy-Peyret, J.-M. Flaud, and A. Perrin *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 179-186 Sponsored by INSU and CNES (For primary document see N92-24589 15-12)
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N92-24622# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
IN SITU STRATOSPHERIC MINOR SPECIES MEASUREMENTS IN THE ARCTIC REGIONS UP TO 30 km ALTITUDES
P. Aimedieu, Y. Kondo, M. Koike, S. Iwasaki, D. Murcray, F. Murcray, W. A. Matthews, P. Johnston, W. R. Sheldon, and B. Sen (Houston Univ., TX.) et al *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 195-199 In FRENCH; ENGLISH summary Sponsored by CNES; Nagoya Univ.; Denver Univ.; Houston Univ.; and Dept. of Scientific and Industrial Research (For primary document see N92-24589 15-12)
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N92-24625# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Service d'Aeronomie.
A LIGHT UV-VISIBLE SPECTROMETER FOR ATMOSPHERIC COMPOSITION MEASUREMENTS BY SOLAR OCCULTATION
J. P. Pommereau, J. Piquard, and F. Goutail *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 215-218 (For primary document see N92-24589 15-12)
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N92-24626# Central Aerological Observatory, Dolgoprudnyi (USSR).
BALLOON MEASUREMENTS OF THE MIDDLE ATMOSPHERE PARAMETERS USING MICROWAVE SPECTROMETERS
A. A. Vlasov, E. N. Kadygrov, and M. G. Sorokin *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 219-222 (For primary document see N92-24589 15-12)
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N92-24644# Centre National d'Etudes Spatiales, Toulouse (France).
APPLICATION OF LIMIT FLYING BALLOONS TO THE STUDY OF THE PLANETARY BOUNDARY LAYER [APPLICATION DES BALLONS PLAFONNANTS A L'ETUDE DE LA COUCHE LIMITE PLANETAIRE]
B. Dartiguelongue, P. Malaterre, B. Benech, A. Hammam, and A. Druilhet (Toulouse Univ., France) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 315-320 In FRENCH (For primary document see N92-24589 15-12)
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N92-24654# Wuppertal Univ. (Germany, F.R.). Dept. of Physics.
DYANA PROJECT SURVEY
D. Offermann *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 369-386 (For primary document see N92-24589 15-12)
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N92-24655# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (Germany, F.R.).
SOME NEW OBSERVATIONS AND RESULTS OBTAINED BY THE FOIL CHAFF TECHNIQUE: VERY HIGH WIND VELOCITIES AND SOLITARY WAVES IN THE MESOSPHERE
H.-U. Widdel *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 387-389 (For primary document see N92-24589 15-12)
(Contracts BMFT-01-OE-0610; BMFT-01-OE-86033; BMFT-01-OE-88042)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24656# Academia Sinica, Beijing (China). Inst. for Space Sciences and Technology.
TURBULENCE SPECTRUM OBSERVED ON A FOIL CLOUD EXPERIMENT LAUNCHED ON 22 FEBRUARY 1991 1906 UT AT BISCARROSSE, SOUTHWEST FRANCE (44 DEG N, 1 DEG W)
Yong-Fu Wu and H.-U. Widdel (Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau, Germany, F.R.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 391-392 (For primary document see N92-24589 15-12)
(Contract BMFT-01-OE-88042)
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N92-24657# Bonn Univ. (Germany, F.R.). Inst. fuer Physik.
DETERMINATION OF RICHARDSON NUMBERS IN THE MESOPAUSE REGION
A. Bacher and U. vonZahn *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 393-397 (For primary document see N92-24589 15-12)
(Contract BMFT-01-OE-88027)
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N92-24658# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (Germany, F.R.).
SIMULTANEOUS RADAR AND LIDAR OBSERVATIONS DURING THE DYANA-CAMPAIGN
P. Czechowsky, B. Inhester, J. Klostermeyer, R. Ruester, and G. Schmidt *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 399-405 (For primary document see N92-24589 15-12)
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N92-24659# Freie Univ., Berlin (Germany, F.R.). Inst. fuer Meteorologie.
A NOTE ON THE INTERANNUAL VARIABILITY OF THE POLAR VORTEX IN THE ARCTIC
K. Labitzke *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 407-411 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24660# Swedish Inst. of Space Physics, Lycksele.
MEASUREMENTS FROM THE EISCAT RADAR DURING DYANA
S. Kirkwood, T. Blix, U.-P. Hoppe, I. Haeggstroem, and U. vonZahn (Bonn Univ., Germany, F.R.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 413-418 (For primary document see N92-24589 15-12)
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N92-24661# Instituto Nacional de Tecnica Aeroespacial, Huelva (Spain). El Arenosillo Sounding Range.
COUPLING STRATOSPHERE-LOWER IONOSPHERE AT MIDDLE LATITUDES
B. A. delaMorena, F. Caballero, and A. Gimenez *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 419-422 (For primary document see N92-24589 15-12)
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N92-24662# Wuppertal Univ. (Germany, F.R.). Dept. of Physics.
ROCKET-BORNE INFRARED MEASUREMENTS IN THE ARCTIC UPPER ATMOSPHERE
K. U. Grossmann, D. Homann, and J. Schulz *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 423-427 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24663# Phillips Lab., Hanscom AFB, MA. Geophysics Directorate.
TWILIGHT MEASUREMENTS OF HIGH-LATITUDE ATMOSPHERIC MINOR SPECIES DURING THE DYANA CAMPAIGN
A. Ratkowski and J. Ulwick (Utah State Univ., Bedford, MA.) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 429-435 (For primary document see N92-24589 15-12)
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N92-24664# Norwegian Defence Research Establishment, Kjeller.
MIDDLE ATMOSPHERE TURBULENCE AT HIGH AND MIDDLE LATITUDES
T. A. Blix and E. V. Thrane *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 437-442 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N92-24564 Physics and Electronics Lab. TNO, The Hague (Netherlands).
AN AUTOMATIC METEOROLOGICAL STATION Final Report
R. vanderTouw Nov. 1991 36 p
(FEL-91-B202; TD91-3894; ETN-92-91224) Copyright Avail: TNO Physics and Electronics Lab., P.O. Box 96864, 2509 JG The Hague, Netherlands

An automatic weather station to support IR measurements in the field is described. After installation this station autonomously collects averaged data. The average is taken over the last 5 minutes interval and stored. The station can run unattended for at least a week. Meteorological parameters, data acquisition, and cables and connectors are described. The METEO software listing is annexed. ESA

N92-25138# Lawrence Livermore National Lab., CA.
WIND/TORNADO GUIDELINES STUDY
D. S. Ng and G. S. Holman Oct. 1991 13 p Presented at the Natural Phenomena Hazards Mitigation Conference, St. Louis, MO, 15-18 Oct. 1991
(Contract W-7405-eng-48)
(DE92-007302; UCRL-JC-108907; CONF-9110122-18) Avail: NTIS HC/MF A03

This report documents the strategy employed to develop recommended wind/tornado hazard design guidelines for a New Production Reactor (NPR) currently planned for either the Idaho National Engineering Laboratory (INEL) or the Savannah River (SR) site. The Wind/Tornado Working Group (WTWG), comprising six nationally recognized experts in structural engineering, wind engineering, and meteorology, formulated an independent set of guidelines based on site-specific wind/tornado hazard curves and state-of-the-art tornado missile technology. The basic philosophy was to select realistic wind and missile load specifications, and to meet performance goals by applying conservative structural response evaluation and acceptance criteria. Simplified probabilistic risk analyses (PRAs) for wind speeds and missile impact were performed to estimate annual damage risk frequencies for both the INEL and SR sites. These PRAs indicate that the guidelines will lead to facilities that meet the US Department of Energy (DOE)

design requirements and that the Nuclear Regulatory Commission guidelines adopted by the DOE for design are adequate to meet the NPR safety goals. DOE

N92-24352# Bonn Univ. (Germany, F.R.). Inst. fuer Geographie.
STUDIES OF FOG IN THE ALPS USING DIGITAL SATELLITE DATA [NEBELSTUDIEN IM ALPENRAUM MIT DIGITALEN SATELLITENDATEN]
M. Bachmann and J. Bendix *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 15-16 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24353# Bonn Univ. (Germany, F.R.). Inst. fuer Geographie.
DETERMINATION OF PRECIPITATION FROM METEOSAT DATA [NIEDERSCHLAGSBESTIMMUNG AUS METEOSAT-DATEN]
G. Menz and A. Vaculik *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 17-18 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N92-24250*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
NASA SEA ICE VALIDATION PROGRAM FOR THE DEFENSE METEOROLOGICAL SATELLITE PROGRAM SPECIAL SENSOR MICROWAVE IMAGER Final Report
Donald J. Cavalieri, ed., John P. Crawford, Mark R. Drinkwater, William J. Emery, Duane T. Eppler, L. Dennis Farmer, Charles W. Fowler, Mark Goodberlet, Robert R. Jentz, and Andrew Milman (Environmental Research Inst. of Michigan, Ann Arbor.) et al Jan. 1992 112 p Original contains color illustrations
(NASA-TM-104559; NAS 1.15:104559; Rept-92B00031) Avail: NTIS HC/MF A06; 4 functional color pages CSCL 08C

The history of the program is described along with the SSM/I sensor, including its calibration and geolocation correction procedures used by NASA, SSM/I data flow, and the NASA program to distribute polar gridded SSM/I radiances and sea ice concentrations (SIC) on CD-ROMs. Following a discussion of the NASA algorithm used to convert SSM/I radiances to SICs, results of 95 SSM/I-MSS Landsat IC comparisons for regions in both the Arctic and the Antarctic are presented. The Landsat comparisons show that the overall algorithm accuracy under winter conditions is 7 pct. on average with 4 pct. negative bias. Next, high resolution active and passive microwave image mosaics from coordinated NASA and Navy aircraft underflights over regions of the Beaufort and Chukchi seas in March 1988 were used to show that the algorithm multiyear IC accuracy is 11 pct. on average with a positive bias of 12 pct. Ice edge crossings of the Bering Sea by the NASA DC-8 aircraft were used to show that the SSM/I 15 pct. ice concentration contour corresponds best to the location of the initial bands at the ice edge. Finally, a summary of results and recommendations for improving the SIC retrievals from spaceborne radiometers are provided. Author

N92-24848# Oak Ridge National Lab., TN.
INTERHEMISPHERIC TRANSPORT OF CARBON THROUGH THE OCEAN
W. S. Broecker (Lamont-Doherty Geological Observatory, Palisades, NY.) and Tsung-Hung Peng Dec. 1991 22 p Presented at the 2nd Ciocco Global Cycle Meeting, Ciocco (Italy), 8-20 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE92-007246; CONF-9109340-2) Avail: NTIS HC/MF A03

A case is made that the Atlantic's conveyor circulation carries roughly 0.6 gigatons of carbon (as (Sigma)CO2) from the northern to the southern hemisphere. The return transport of this carbon (as CO2) through the atmosphere would maintain a 1.6 ppm south to north gradient in atmospheric CO2 content. Such a gradient would go a long way toward explaining the current lower than expected fossil fuel CO2 supported north to south atmospheric gradient and hence would alleviate the necessity for the large northern hemisphere terrestrial sink that was recently proposed. DOE

N92-24357# Observatorium Hoher List, Daun (Germany, F.R.).
EARTH ROTATION AND OCEANS: EFFECTS OF TIDES AND OCEAN FLOWS ON THE POSITION OF THE EARTH IN SPACE [ERDROTATION UND OZEANE: EINFLUESSE VON GEZEITEN UND OZEANISCHEN STROEMUNGEN AUF DIE STELLUNG DER ERDE IM RAUM]
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 29-30 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

51 LIFE SCIENCES (GENERAL)

N92-24683# California Univ., Irvine. Dept. of Ecology and Evolutionary Biology.
GENETIC VARIATION IN RESISTANCE TO IONIZING RADIATION
F. J. Ayala 24 Jun. 1991 12 p
(Contract DE-FG03-88ER-60713)
(DE92-005588; DOE/ER-60713/T1) Avail: NTIS HC/MF A03

We proposed an investigation of genetically determined individual differences in sensitivity to ionizing radiation. The model organism is Drosophila melanogaster. The gene coding for Cu, Zn superoxide dismutase (SOD) is the target locus, but the effects of variation in other components of the genome that modulate SOD levels are also taken into account. SOD scavenges oxygen radicals generated during exposure to ionizing radiation. It has been shown to protect against ionizing radiation damage to DNA, viruses, bacteria, mammalian cells, whole mice, and Drosophila. Two alleles, S and F, are commonly found in natural populations of D. melanogaster; in addition we have isolated from a natural population 'null' (CA1) mutant that yields only 3.5 pct. of normal SOD activity. The S, F, and CA1 alleles provide an ideal model system to investigate SOD-dependent radioresistance, because each allele yields different levels of SOD, so that S is greater than F is much greater than CA1. The roles of SOD level in radioresistance are being investigated in a series of experiments that measure the somatic and germ-line effects of increasing doses of ionizing radiation. In addition, we have pursued an unexpected genetic event-namely the nearly simultaneous transformation of several lines homozygous for the SOD 'null' allele into predominately S lines. Using specifically designed probes and DNA amplification by means of the Tag polymerase chain reaction (PCR) we have shown that (1) the null allele was still present in the transformed lines, but was being gradually replaced by the S allele as a consequence of natural selection; and (2) that the transformation was due to the spontaneous deletion of a 0.68 Kb truncated P-element, the insertion of which is characteristic of the CA1 null allele. DOE

N92-25047# Maryland Univ., College Park. Dept. of Botany.
ACTIVE AND PASSIVE CALCIUM TRANSPORT SYSTEMS IN PLANT CELLS
H. Sze 1991 6 p
(Contract DE-FG05-86ER-13461)
(DE92-005469; DOE/ER-13461/6) Avail: NTIS HC/MF A02

The ability to change cytoplasmic Ca(2+) levels ((Ca(2+))) by cells has made this cation a key regulator of many biological processes. Cytoplasmic (Ca(2+)) is determined by the coordination of passive Ca(2+) fluxes which increase cytosolic (Ca(2+)) and active Ca(2+) transport systems that lower cytosolic (Ca(2+)). The mechanisms by which plant cells achieve this is poorly understood. We have initially used isolated vesicles from the plasma membrane or organellar membranes to study Ca(2+) transport systems in oat roots (a monocot) and carrot suspension cells (a dicot). The objectives of the proposal were to identify and characterize active (energy-dependent) and passive calcium transport systems that work together to regulate calcium levels in the cytoplasm of plant cells. DOE

N92-25000*# National Inst. of Health, Bethesda, MD. Office of Science Policy.
NATIONAL INSTITUTES OF HEALTH PRESENTATION AT IPE CONFERENCE PROGRAM
Caroline Holloway *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 165-175
(For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 06A

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N92-24672# Los Alamos National Lab., NM.
ELECTROMAGNETIC IMAGING OF DYNAMIC BRAIN ACTIVITY
J. Mosher, R. Leahy, P. Lewis, J. Lewine, J. George, and M. Singh (University of Southern California, Los Angeles.) 1991 5 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract W-7405-eng-36)
(DE92-005017; LA-UR-91-3870; CONF-911106-56) Avail: NTIS HC/MF A01

Neural activity in the brain produces weak dynamic electromagnetic fields that can be measured by an array of sensors. Using a spatio-temporal modeling framework, we have developed a new approach to localization of multiple neural sources. This approach is based on the MUSIC algorithm originally developed for estimating the direction of arrival of signals impinging on a sensor array. We present applications of this technique to magnetic field measurements of a phantom and of a human evoked somatosensory response. The results of the somatosensory localization are mapped onto the brain anatomy obtained from magnetic resonance images. DOE

N92-24899# Mount Sinai School of Medicine, New York, NY. Dept. of Physiology and Biophysics.
MOLECULAR MECHANISMS IN RADIATION DAMAGE TO DNA
R. Osman 28 Oct. 1991 2 p
(Contract DE-FG02-88ER-60675)
(DE92-008799; DOE/ER-60675/5) Avail: NTIS HC/MF A01

The objectives of this work are to elucidate the molecular mechanisms that are responsible for radiation-induced DNA damage. The overall goal is to understand the relationship between the chemical and structural changes produced by ionizing radiation in DNA and the resulting impairment of biological function expressed as carcinogenesis or cell death. The studies are based on theoretical explorations of possible mechanisms that link initial radiation damage in the form of base and sugar damage to conformational changes in DNA. These mechanistic explorations should lead to the formulation of testable hypothesis regarding the processes of impairment of regulation of gene expression, alternation in DNA repair, and damage to DNA structure involved in cell death or cancer. DOE

N92-25045# Brookhaven National Lab., Upton, NY.
MEDICAL APPLICATIONS OF SYNCHROTRON RADIATION
W. Thomlinson Oct. 1991 26 p Presented at the 7th National Conference and Exhibition on Synchrotron Radiation Instrumentation, Baton Rouge, LA, 28-31 Oct. 1991
(Contract DE-AC02-76CH-00016)
(DE92-005041; BNL-46865; CONF-9110146-5) Avail: NTIS HC/MF A03

Ever since the first diagnostic x-ray was done in the United States on 3 Feb. 1896, the application of ionizing radiation to the field of medicine has become increasingly important. Both in clinical medicine and basic research the use of x-rays for diagnostic imaging and radiotherapy is now widespread. Radiography, angiography, CAT and PETT scanning, mammography, and nuclear medicine are all examples of technologies developed to image the human anatomy. In therapeutic applications, both external and internal sources of radiation are applied to the battle against cancer. The development of dedicated synchrotron radiation sources has allowed exciting advances to take place in many of these applications. The new sources provide tunable, high-intensity monochromatic beams over a wide range of energies which can be tailored to specific programmatic needs. This paper surveys those areas of medical research in which synchrotron radiation facilities are actively involved. DOE

N92-25046# Lawrence Livermore National Lab., CA.
ABSOLUTE CALIBRATION OF IN VIVO MEASUREMENT SYSTEMS USING MAGNETIC RESONANCE IMAGING AND MONTE CARLO COMPUTATIONS
M. W. Mallett (Texas A&M Univ., College Station.), D. P. Hickman, and D. A. Kruchten 1991 4 p Presented at the 8th International Radiation Protection Association Conference, Montreal, Quebec, 17-22 May 1992
(Contract W-7405-eng-48)
(DE92-005253; UCRL-JC-106915; CONF-920501-14) Avail: NTIS HC/MF A01

Lawrence Livermore National Laboratory (LLNL) is currently investigating a new method for obtaining absolute calibration factors for radiation measurement systems used to measure internally deposited radionuclides in vivo. This method uses magnetic resonance imaging (MRI) to determine the anatomical makeup of an individual. A new MRI technique is also employed that is capable of resolving the fat and water content of the human tissue. This anatomical and biochemical information is used to model a mathematical phantom. Monte Carlo methods are then used to simulate the transport of radiation throughout the phantom. By modeling the detection equipment of the in vivo measurement system into the code, calibration factors are generated that are specific to the individual. Furthermore, this method eliminates the need for surrogate human structures in the calibration process. A demonstration of the proposed method is being performed using a fat/water matrix. DOE

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

No abstracts in this category.

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N92-24293# California Univ., Berkeley. Lawrence Berkeley Lab.
AIR EXCHANGE EFFECTIVENESS OF CONVENTIONAL AND TASK VENTILATION FOR OFFICES
W. J. Fisk, D. Faulkner, and R. J. Prill Dec. 1991 11 p Presented at the IAQ 1991: Healthy Buildings, Washington, DC, 4-8 Sep. 1991
(Contract DE-AC03-76SF-00098)
(DE92-008291; LBL-31652; CONF-910979-1) Avail: NTIS HC/MF A03

Air quality and comfort complaints within large buildings are often attributed to air distribution problems. We define three air exchange effectiveness parameters related to air distribution. The first two indicate the indoor air flow pattern (i.e., the extent of short circuiting, mixing, or displacement flow) for an entire building or region. The third parameter is most useful for assessments of the spatial variability of ventilation. We also define the air diffusion effectiveness which indicates the air flow pattern within specific rooms or sections of buildings. The results of measurements of these parameters in U.S. office buildings by the authors and other researchers are reviewed. Almost all measurements indicate very limited short circuiting or displacement flow between locations of air supply and removal. However, a moderate degree of short circuiting is evident from a few measurements in rooms with heated supply air. The results of laboratory-based measurements by the authors are consistent with the field data. Our measurements in office buildings do indicate that ventilation rates can vary substantially between indoor locations, probably due to variation in air supply rates between locations rather than variation in the indoor air flow patterns. One possible method of improving air distribution is to employ task ventilation with air supplied closer to the occupant's breathing zone. We have evaluated two task ventilation systems in a laboratory setting. During most operating conditions, these systems did not provide a region of substantially increased ventilation where occupants breathe. However, both systems are capable of providing substantially enhanced ventilation at the breathing zone under some operating conditions. Therefore, task ventilation is a potential option for using ventilation air more effectively. DOE

N92-24793*# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
PROJECT WISH: THE EMERALD CITY, PHASE 2
Jun. 1991 112 p
(Contract NASw-4435)
(NASA-CR-190011; NAS 1.26:190011) Avail: NTIS HC/MF A06 CSCL 06K

The purpose of the Permanently Manned Autonomous Space Oasis, designated Project WISH: The Emerald City, is to serve as permanent living quarters for space colonists. In addition, it will serve as a stopover for space missions and will be capable of restationing itself practically anywhere within the solar system to provide support for these missions. The station should be self-sufficient, with no specific dependence on any resources from Earth. The 1990 to 1991 design team continued work started by last year's class. Further studies were conducted in the areas of orbital mechanics, propulsion, attitude control, and human factors. Critical elements were identified in each of these areas, and guidelines were established for the design of the Emerald City. Using the knowledge gained from these studies, two particular missions of interest, a Saturn Envelope mission and an Earth to Mars mission, were examined. The size and mass estimates, along with the methodologies used in their determination, are considered to be the main accomplishments of phase 2. Author

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

N92-24323*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
USING SINGLE BUFFERS AND DATA REORGANIZATION TO IMPLEMENT A MULTI-MEGASAMPLE FAST FOURIER TRANSFORM
R. D. Brown *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 294-306 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 06L

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N92-24283# Los Alamos National Lab., NM.
SUPERCOMPUTER DEBUGGING WORKSHOP 1991 PROCEEDINGS
J. Brown 1991 404 p Presented at the Conference on Supercomputing 1991, Albuquerque, NM, 14-16 Nov. 1991
(Contract W-7405-eng-36)
(DE92-008476; LA-UR-92-562; CONF-911103) Avail: NTIS HC/MF A18

This report discusses the following topics on supercomputer debugging: Distributed debugging; use interface to debugging tools and standards; debugging optimized codes; debugging parallel codes; and debugger performance and interface as analysis tools. DOE

N92-24490# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Attitude and Orbit Control Section.
ADVANCED FAULT TOLERANT AOCS COMPUTER FOR RENDEZVOUS AND DOCKING MISSIONS
A. T. Sund, J. Tailhades, and P. Linden (Saab Space A.B., Goeteborg, Sweden) *In its* Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 447-454 (For primary document see N92-24432 15-18)
Copyright Avail: NTIS HC/MF A99

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N92-24221# Sandia National Labs., Livermore, CA.
OVERVIEW OF THE DART PROJECT
K. R. Berry, F. R. Hansen, L. M. Napolitano, E. L. McKelvey, D. D. Andaleon, and J. E. Leeper Jan. 1992 30 p

(Contract DE-AC04-76DR-00789)
(DE92-007014; SAND-91-8238) Avail: NTIS HC/MF A03

DART (DSP Array for Reconfigurable Tasks) is a parallel architecture of two high-performance DSP (digital signal processing) chips with the flexibility to handle a wide range of real-time applications. Each of the 32-bit floating-point DSP processes in DART is programmable in a high-level language (C or Ada). We have added extensions to the real-time operating system used by DART in order to support parallel processing. The combination of high-level language programmability, a real-time operating system, and parallel processing support significantly reduces the development cost of application software for signal processing and control applications. We have demonstrated this capability by using DART to reconstruct images in the prototype VIP (Video Imaging Projectile) groundstation. DOE

N92-24297# Mitre Corp., McLean, VA. Jason Program Office.
CHAMMP REVIEW
H. Abarbanel, P. Collela, A. Despain, S. Koonin, C. Leith, H. Levine, G. MacDonald, N. Metroplis, W. Nierenberg, and G. North et al Jan. 1992 67 p
(Contract DE-AI05-90ER-30174)
(DE92-008516; JSR-90-306) Avail: NTIS HC/MF A04

CHAMMP (Computer Hardware, Advanced Mathematics and Model Physics) is a new DOE program designed to move climate models from the current generation of supercomputers to massively parallel computers of the future. The general computing goal of CHAMMP is to provide a ten thousandfold increase in computing speed. Within the current climate modeling community, the primary motivation for increased speed is the desire to achieve much higher geographical resolution in the models, which would allow the 'regional' predictions desired by policy makers. As planning for CHAMMP has evolved, issues other than those of spatial resolution have received increased attention. These issues include predictability, improvement of model performance by use of modern software engineering, the relationship of CHAMMP to other proposed modeling efforts, etc. This report provides an overview of these issues. DOE

N92-24397*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SOFTWARE SURFACE MODELING AND GRID GENERATION STEERING COMMITTEE
Robert E. Smith, ed. Washington Apr. 1992 510 p Workshop held in Hampton, VA, 28-30 Apr. 1992; sponsored by NASA, Washington
(NASA-CP-3143; L-17093; NAS 1.55:3143) Avail: NTIS HC/MF A22 CSCL 09B

It is a NASA objective to promote improvements in the capability and efficiency of computational fluid dynamics. Grid generation, the creation of a discrete representation of the solution domain, is an essential part of computational fluid dynamics. However, grid generation about complex boundaries requires sophisticated surface-model descriptions of the boundaries. The surface modeling and the associated computation of surface grids consume an extremely large percentage of the total time required for volume grid generation. Efficient and user friendly software systems for surface modeling and grid generation are critical for computational fluid dynamics to reach its potential. The papers presented here represent the state-of-the-art in software systems for surface modeling and grid generation. Several papers describe improved techniques for grid generation. For individual titles, see N92-24398 through N92-24431.

N92-24398*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE NASA-IGES GEOMETRY DATA EXCHANGE STANDARD
c82
Matthew W. Blake, Jin J. Chou, Patricia A. Kerr, and Scott A. Thorp (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 1-6 (For primary document see N92-24397 15-61)
(Contract NAS2-12961)
Avail: NTIS HC/MF A22 CSCL 05B

Described here are the data exchange efforts and plans supported by the NASA Steering Committee for Surface Modeling and Grid Generation. Current methods for geometry data exchange between computer aided design (CAD) systems and NASA computational fluid dynamics (CFD) analysis systems are tedious and induce errors. A Geometry Data Exchange Standard is proposed, utilizing a subset of an existing national standard titled Initial Graphic Exchange Standard (IGES). Future plans for data exchange standardization include all aspects of CFD data. Software systems to utilize this NASA-IGES Geometry Data Exchange Specification are under development. Author

N92-24399*# Boeing Commercial Airplane Co., Seattle, WA. Aerodynamics Research and Engineering Div.
REQUIREMENTS FOR A GEOMETRY PROGRAMMING LANGUAGE FOR CFD APPLICATIONS
Arvel E. Gentry *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 7-29 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

A number of typical problems faced by the aerodynamicist in using computational fluid dynamics are presented to illustrate the need for a geometry programming language. The overall requirements for such a language are illustrated by examples from the Boeing Aero Grid and Paneling System (AGPS). Some of the problems in building such a system are also reviewed along with suggestions as to what to look for when evaluating new software problems. Author

N92-24400*# McDonnell Aircraft Co., Saint Louis, MO.
GEOMETRY ACQUISITION AND GRID GENERATION: RECENT EXPERIENCES WITH COMPLEX AIRCRAFT CONFIGURATIONS
Timothy D. Gatzke, Walter F. LaBozzetta, John W. Cooley, and Gregory P. Finfrock *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 31-43 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

Important issues involved in working with complex geometries are discussed. Approaches taken to address complex geometry issues in the McDonnell Aircraft Computational Grid System and related geometry processing tools are discussed. The efficiency of acquiring a suitable geometry definition, the need to manipulate the geometry, and the time and skill level required to generate the grid while preserving geometric fidelity are discussed. Author

N92-24401*# Wright Lab., Eglin AFB, FL. Weapon Flight Mechanics Div.
SDL: A SURFACE DESCRIPTION LANGUAGE
Raymond C. Maple *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 45-58 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

A new interpreted language specifically designed for surface grid generation is introduced. Many unique aspects of the language are discussed, including the farray, vector, curve, and surface data types and the operators used to manipulate them. Custom subroutine libraries written in the language are used to easily build surface grids for generic missile shapes. Author

N92-24402*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
S3D: AN INTERACTIVE SURFACE GRID GENERATION TOOL
Raymond Ching-Chung Luh, Lawrence E. Pierce (Sterling Software, Moffett Field, CA.), and David Yip *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 59-67 (For primary document see N92-24397 15-61)
(Contracts NAS2-13210; NCC2-513)
Avail: NTIS HC/MF A22 CSCL 09B

S3D, an interactive software tool for surface grid generation, is described. S3D provides the means with which a geometry definition based either on a discretized curve set or a rectangular set can be quickly processed towards the generation of a surface grid for computational fluid dynamics (CFD) applications. This is made possible as a result of implementing commonly encountered surface gridding tasks in an environment with a highly efficient and user friendly graphical interface. Some of the more advanced features of S3D include surface-surface intersections, optimized surface domain decomposition and recomposition, and automated propagation of edge distributions to surrounding grids. Author

N92-24403*# Sverdrup Technology, Inc., Huntsville, AL. Structures and Dynamics Dept.

ELLIPTIC SURFACE GRID GENERATION IN THREE-DIMENSIONAL SPACE

Lee Kania *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 69-86 (For primary document see N92-24397 15-61)

Avail: NTIS HC/MF A22 CSCL 09B

A methodology for surface grid generation in three dimensional space is described. The method solves a Poisson equation for each coordinate on arbitrary surfaces using successive line over-relaxation. The complete surface curvature terms were discretized and retained within the nonhomogeneous term in order to preserve surface definition; there is no need for conventional surface splines. Control functions were formulated to permit control of grid orthogonality and spacing. A method for interpolation of control functions into the domain was devised which permits their specification not only at the surface boundaries but within the interior as well. An interactive surface generation code which makes use of this methodology is currently under development. Author

N92-24404*# Sverdrup Technology, Inc., Eglin AFB, FL.

IGGy: AN INTERACTIVE ENVIRONMENT FOR SURFACE GRID GENERATION

Nathan C. Prewitt *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 87-106 Sponsored in part by AF Development Test Center (For primary document see N92-24397 15-61)

Avail: NTIS HC/MF A22 CSCL 09B

A graphically interactive derivative of the EAGLE boundary code is presented. This code allows the user to interactively build and execute commands and immediately see the results. Strong ties with a batch oriented script language are maintained. A generalized treatment of grid definition parameters allows a more generic definition of the grid generation process and allows the generation of command scripts which can be applied to topologically similar configurations. The use of the graphical user interface is outlined and example applications are presented. Author

N92-24405*# Sverdrup Technology, Inc., Huntsville, AL. Structures and Dynamics Dept.

ALGEBRAIC SURFACE GRID GENERATION IN THREE-DIMENSIONAL SPACE

Saif Warsi *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 107-119 (For primary document see N92-24397 15-61)

Avail: NTIS HC/MF A22 CSCL 09B

An interactive program for algebraic generation of structured surface grids in three dimensional space was developed on the IRIS4D series workstations. Interactive tools are available to ease construction of edge curves and surfaces in 3-D space. Addition, removal, or redistribution of points at arbitrary locations on a general 3-D surface or curve is possible. Also, redistribution of surface grid points may be accomplished through use of conventional surface splines or a method called 'surface constrained transfinite interpolation'. This method allows the user to redistribute the grid points on the edges of a surface patch; the effect of the redistribution is then propagated to the remainder of the surface through a transfinite interpolation procedure where the grid points will be constrained to lie on the surface. The program was written to be highly functional and easy to use. A host of utilities are available to ease the grid generation process. Generality of the program allows the creation of single and multizonal surface grids according to the user requirements. The program communicates with the user through popup menus, windows, and the mouse. Author

N92-24406*# Purdue Univ., West Lafayette, IN. Dept. of Computer Science.

ALGEBRAIC SURFACE DESIGN AND FINITE ELEMENT MESHES

Chandrajit L. Bajaj *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 121-131 (For primary document see N92-24397 15-61)

(Grants NSF CCR-90-02228; NSF DMS-91-01424; AF-AFOSR-0276-91)

Avail: NTIS HC/MF A22 CSCL 09B

Some of the techniques are summarized which are used in constructing C sup 0 and C sup 1 continuous meshes of low degree, implicitly defined, algebraic surface patches in three dimensional space. These meshes of low degree algebraic surface patches are used to construct accurate computer models of physical objects. These meshes are also used in the finite element simulation of physical phenomena (e.g., heat dissipation, stress/strain distributions, fluid flow characteristics) required in the computer prototyping of both the manufacturability and functionality of the geometric design. Author

N92-24407*# Boeing Computer Services Co., Seattle, WA.

PRACTICAL QUALITY CONTROL TOOLS FOR CURVES AND SURFACES

Scott G. Small *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 133-147 (For primary document see N92-24397 15-61)

Avail: NTIS HC/MF A22 CSCL 09B

Curves (geometry) and surfaces created by Computer Aided Geometric Design systems in the engineering environment must satisfy two basic quality criteria: the geometric shape must have the desired engineering properties; and the objects must be parameterized in a way which does not cause computational difficulty for geometric processing and engineering analysis. Interactive techniques are described which are in use at Boeing to evaluate the quality of aircraft geometry prior to Computational Fluid Dynamic analysis, including newly developed methods for examining surface parameterization and its effects. Author

N92-24408*# TRW, Inc., San Bernardino, CA. Ballistic Missiles Div.

THREE-DIMENSIONAL SURFACE GRID GENERATION FOR CALCULATION OF THERMAL RADIATION SHAPE FACTORS

Hany M. Aly *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 149-159 (For primary document see N92-24397 15-61)

Avail: NTIS HC/MF A22 CSCL 09B

A technique is described to generate three dimensional surface grids suitable for calculating shape factors for thermal radiative heat transfer. The surface under consideration is approximated by finite triangular elements generated in a special manner. The grid is generated by dividing the surface into a two dimensional array of nodes. Each node is defined by its coordinates. Each set of four adjacent nodes is used to construct two triangular elements. Each triangular element is characterized by the vector representation of its vertices. Vector algebra is used to calculate all desired geometric properties of grid elements. The properties are used to determine the shape factor between the element and an area element in space. The grid generation can be graphically displayed using any software with three dimensional features. DISSPLA was used to view the grids. Author

N92-24409*# Control Data Corp., Irvine, CA.
INTEGRATED GEOMETRY AND GRID GENERATION SYSTEM FOR COMPLEX CONFIGURATIONS
Vedat Akdag and Armin Wulf *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 161-171 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

A grid generation system was developed that enables grid generation for complex configurations. The system called ICEM/CFD is described and its role in computational fluid dynamics (CFD) applications is presented. The capabilities of the system include full computer aided design (CAD), grid generation on the actual CAD geometry definition using robust surface projection algorithms, interfacing easily with known CAD packages through common file formats for geometry transfer, grid quality evaluation of the volume grid, coupling boundary condition set-up for block faces with grid topology generation, multi-block grid generation with or without point continuity and block to block interface requirement, and generating grid files directly compatible with known flow solvers. The interactive and integrated approach to the problem of computational grid generation not only substantially reduces manpower time but also increases the flexibility of later grid modifications and enhancements which is required in an environment where CFD is integrated into a product design cycle. Author

N92-24410*# Program Development Corp., White Plains, NY.
GRIDMAN: A GRID MANIPULATION SYSTEM
Peter R. Eiseman and Zhu Wang *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 173-205 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

GridMan is an interactive grid manipulation system. It operates on grids to produce new grids which conform to user demands. The input grids are not constrained to come from any particular source. They may be generated by algebraic methods, elliptic methods, hyperbolic methods, parabolic methods, or some combination of methods. The methods are included in the various available structured grid generation codes. These codes perform the basic assembly function for the various elements of the initial grid. For block structured grids, the assembly can be quite complex due to a large number of clock corners, edges, and faces for which various connections and orientations must be properly identified. The grid generation codes are distinguished among themselves by their balance between interactive and automatic actions and by their modest variations in control. The basic form of GridMan provides a much more substantial level of grid control and will take its input from any of the structured grid generation codes. The communication link to the outside codes is a data file which contains the grid or section of grid. Author

N92-24411*# National Aerospace Lab., Amsterdam (Netherlands).
DOMAIN MODELING AND GRID GENERATION FOR MULTI-BLOCK STRUCTURED GRIDS WITH APPLICATION TO AERODYNAMIC AND HYDRODYNAMIC CONFIGURATIONS
S. P. Spekreijse, J. W. Boerstoel, P. L. Vitagliano, and J. L. Kuyvenhoven (Fokker B.V., Schipol-Oost, Netherlands) *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 207-229 (For primary document see N92-24397 15-61)
(Contract NIVR-01604-N)
Avail: NTIS HC/MF A22 CSCL 09B

About five years ago, a joint development was started of a flow simulation system for engine-airframe integration studies on propeller as well as jet aircraft. The initial system was based on the Euler equations and made operational for industrial aerodynamic design work. The system consists of three major components: a domain modeller, for the graphical interactive subdivision of flow domains into an unstructured collection of blocks; a grid generator, for the graphical interactive computation of structured grids in blocks; and a flow solver, for the computation of flows on multi-block grids. The industrial partners of the collaboration and NLR have demonstrated that the domain modeller, grid generator and flow solver can be applied to simulate Euler flows around complete aircraft, inciuding propulsion system simulation. Extension to Navier-Stokes flows is in progress. Delft Hydraulics has shown that both the domain modeller and grid generator can also be applied successfully for hydrodynamic configurations. An overview is given about the main aspects of both domain modelling and grid generation. Author

N92-24412*# Visual Computing Corp., Mountain View, CA.
TOWARDS A THEORY OF AUTOMATED ELLIPTIC MESH GENERATION
J. Q. Cordova *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 231-241 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

The theory of elliptic mesh generation is reviewed and the fundamental problem of constructing computational space is discussed. It is argued that the construction of computational space is an NP-Complete problem and therefore requires a nonstandard approach for its solution. This leads to the development of graph-theoretic, combinatorial optimization and integer programming algorithms. Methods for the construction of two dimensional computational space are presented. Author

N92-24413*# Mississippi State Univ., Mississippi State. Engineering Research Center.
EAGLEVIEW: A SURFACE AND GRID GENERATION PROGRAM AND ITS DATA MANAGEMENT
M. G. Remotigue, E. T. Hart, and M. L. Stokes *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 243-252 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

An old and proven grid generation code, the EAGLE grid generation package, is given an added dimension of a graphical interface and a real time data base manager. The Numerical Aerodynamic Simulation (NAS) Panel Library is used for the graphical user interface. Through the panels, EAGLEView constructs the EAGLE script command and sends it to EAGLE to be processed. After the object is created, the script is saved in a mini-buffer which can be edited and/or saved and reinterpreted. The graphical objects are set-up in a linked-list and can be selected or queried by pointing and clicking the mouse. The added graphical enhancement to the EAGLE system emphasizes the unique capability to construct field points around complex geometry and visualize the construction every step of the way. Author

N92-24414*# MDA Engineering, Inc., Arlington, TX.
RECENT ENHANCEMENTS TO THE GRIDGEN STRUCTURED GRID GENERATION SYSTEM
John P. Steinbrenner and John R. Chawner *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 253-271 Sponsored in part by AFWAL Prepared for Computer Sciences Corp., Hampton, VA (For primary document see N92-24397 15-61)
(Contract NAS1-19038)
Avail: NTIS HC/MF A22 CSCL 09B

Significant enhancements are being implemented into the GRIDGEN3D, multiple block, structured grid generation software. Automatic, point-to-point, interblock connectivity will be possible through the addition of the domain entity to GRIDBLOCK's block construction process. Also, the unification of GRIDGEN2D and GRIDBLOCK has begun with the addition of edge grid point distribution capability to GRIDBLOCK. The geometric accuracy of surface grids and the ease with which databases may be obtained is being improved by adding support for standard computer-aided design formats (e.g., PATRAN Neutral and IGES files). Finally, volume grid quality was improved through addition of new SOR

algorithm features and the new hybrid control function type to GRIDGEN3D. Author

N92-24415*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CELL VOLUME CONTROL AT A SURFACE FOR THREE-DIMENSIONAL GRID GENERATION PACKAGES
Stephen J. Alter (Lockheed Engineering and Sciences Co., Hampton, VA.) and Kenneth J. Weilmuenster *In its* Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 273-298 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

An alternate method of calculating the cell size for orthogonality control in the solution of Poisson's 3D space equations is presented. The method provides the capability to enforce a better initial guess for the grid distribution required for boundary layer resolution. This grid point distribution is accomplished by enforcing grid spacing from a grid block boundary where orthogonality is required. The actual grid spacing or cell size for that boundary is determined by the two or four adjacent boundaries in the grid block definition, which are two dimensional grids. These two dimensional grids are in turn defined by the user using insight into the flow field and boundary layer characteristics. The adjoining boundaries are extended using a multifunctional blending scheme, with user control of the blending and interpolating functions to be used. This grid generation procedure results in an enhanced computational fluid dynamics calculation by allowing a quicker resolution of the configuration's boundary layer and flow field and by limiting the number of grid re-adaptations. The cell size specification calculation was applied to a variety of configurations ranging from axisymmetric to complex three-dimensional configurations. Representative grids are shown for the Space Shuttle and the Langley Lifting Body (HL-20). Author

N92-24416*# Boeing Computer Services Co., Bellevue, WA.
SINGULARITY CLASSIFICATION AS A DESIGN TOOL FOR MULTIBLOCK GRIDS
Alan K. Jones *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 299-314 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

A major stumbling block in interactive design of 3-D multiblock grids is the difficulty of visualizing the design as a whole. One way to make this visualization task easier is to focus, at least in early design stages, on an aspect of the grid which is inherently easy to present graphically, and to conceptualize mentally, namely the nature and location of singularities in the grid. The topological behavior of a multiblock grid design is determined by what happens at its edges and vertices. Only a few of these are in any way exceptional. The exceptional behaviors lie along a singularity graph, which is a 1-D construct embedded in 3-D space. The varieties of singular behavior are limited enough to make useful symbology on a graphics device possible. Furthermore, some forms of block design manipulation that appear appropriate to the early conceptual-modeling phase can be accomplished on this level of abstraction. An overview of a proposed singularity classification scheme and selected examples of corresponding manipulation techniques is presented. Author

N92-24417*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE NASA-IGES GEOMETRY DATA VISUALIZER
Matthew W. Blake, Lonhyn Jasinskyj, and Jin J. Chou (Computer Sciences Corp., Moffett Field, CA.) *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 315-318 (For primary document see N92-24397 15-61)
(Contract NAS2-12961)
Avail: NTIS HC/MF A22 CSCL 09B

NIGESview, an interactive software tool for reading, viewing, and translating geometry data available in the Initial Graphics Exchange Specification (IGES) format, is described. NIGESview is designed to read a variety of IGES entities, translate some of the entities, graphically view the data, and output a file in a specific IGES format. The software provides a modern graphical user interface and is designed in a modular fashion so developers can utilize all or part of the code in their grid generation software for computational fluid dynamics. Author

N92-24418*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
GRAPEVINE: GRIDS ABOUT ANYTHING BY POISSON'S EQUATION IN A VISUALLY INTERACTIVE NETWORKING ENVIRONMENT
Reese L. Sorenson and Karen McCann (Sterling Software, Palo Alto, CA.) *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 319-331 (For primary document see N92-24397 15-61)
(Contract NAS2-13210)
Avail: NTIS HC/MF A22 CSCL 09B

A proven 3-D multiple-block elliptic grid generator, designed to run in 'batch mode' on a supercomputer, is improved by the creation of a modern graphical user interface (GUI) running on a workstation. The two parts are connected in real time by a network. The resultant system offers a significant speedup in the process of preparing and formatting input data and the ability to watch the grid solution converge by replotting the grid at each iteration step. The result is a reduction in user time and CPU time required to generate the grid and an enhanced understanding of the elliptic solution process. This software system, called GRAPEVINE, is described, and certain observations are made concerning the creation of such software. Author

N92-24419*# Boeing Commercial Airplane Co., Seattle, WA. Aerodynamics Research and Engineering Div.
AN INTERACTIVE MULTI-BLOCK GRID GENERATION SYSTEM
T. J. Kao, T. Y. Su, and Ruth Appleby (Boeing Computer Services Co., Seattle, WA.) *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 333-345 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

A grid generation procedure combining interactive and batch grid generation programs was put together to generate multi-block grids for complex aircraft configurations. The interactive section provides the tools for 3D geometry manipulation, surface grid extraction, boundary domain construction for 3D volume grid generation, and block-block relationships and boundary conditions for flow solvers. The procedure improves the flexibility and quality of grid generation to meet the design/analysis requirements. Author

N92-24420*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
INTERACTIVE SOLUTION-ADAPTIVE GRID GENERATION
Yung K. Choo and Todd L. Henderson (Illinois Univ., Urbana.) *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 347-361 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

TURBO-AD is an interactive solution-adaptive grid generation program under development. The program combines an interactive algebraic grid generation technique and a solution-adaptive grid generation technique into a single interactive solution-adaptive grid generation package. The control point form uses a sparse collection of control points to algebraically generate a field grid. This technique provides local grid control capability and is well suited to interactive work due to its speed and efficiency. A mapping from the physical domain to a parametric domain was used to improve difficulties that had been encountered near outwardly concave boundaries in the control point technique. Therefore, all grid modifications are performed on a unit square in the parametric domain, and the new adapted grid in the parametric domain is then mapped back

to the physical domain. The grid adaptation is achieved by first adapting the control points to a numerical solution in the parametric domain using control sources obtained from flow properties. Then a new modified grid is generated from the adapted control net. This solution-adaptive grid generation process is efficient because the number of control points is much less than the number of grid points and the generation of a new grid from the adapted control net is an efficient algebraic process. TURBO-AD provides the user with both local and global grid controls. Author

N92-24421*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MAG3D AND ITS APPLICATION TO INTERNAL FLOWFIELD ANALYSIS
K. D. Lee, T. L. Henderson (Illinois Univ., Urbana.), and Y. K. Choo *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 363-377 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

MAG3D (multiblock adaptive grid, 3D) is a 3D solution-adaptive grid generation code which redistributes grid points to improve the accuracy of a flow solution without increasing the number of grid points. The code is applicable to structured grids with a multiblock topology. It is independent of the original grid generator and the flow solver. The code uses the coordinates of an initial grid and the flow solution interpolated onto the new grid. MAG3D uses a numerical mapping and potential theory to modify the grid distribution based on properties of the flow solution on the initial grid. The adaptation technique is discussed, and the capability of MAG3D is demonstrated with several internal flow examples. Advantages of using solution-adaptive grids are also shown by comparing flow solutions on adaptive grids with those on initial grids. Author

N92-24422*# Mississippi State Univ., Mississippi State. National Science Foundation Engineering Research Center.
ALGEBRAIC GRID ADAPTATION METHOD USING NON-UNIFORM RATIONAL B-SPLINE SURFACE MODELING
Jiann-Cherng Yang and B. K. Soni *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 379-399 Sponsored in part by Teledyne Brown Engineering and AFOSR (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

An algebraic adaptive grid system based on equidistribution law and utilized by the Non-Uniform Rational B-Spline (NURBS) surface for redistribution is presented. A weight function, utilizing a properly weighted boolean sum of various flow field characteristics is developed. Computational examples are presented to demonstrate the success of this technique. Author

N92-24423*# Rutgers - The State Univ., New Brunswick, NJ. Dept. of Computer Science.
USING ARTIFICIAL INTELLIGENCE TO CONTROL FLUID FLOW COMPUTATIONS **c63**
Andrew Gelsey *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 401-413 (For primary document see N92-24397 15-61)
(Grant NAG2-645)
Avail: NTIS HC/MF A22 CSCL 09B

Computational simulation is an essential tool for the prediction of fluid flow. Many powerful simulation programs exist today. However, using these programs to reliably analyze fluid flow and other physical situations requires considerable human effort and expertise to set up a simulation, determine whether the output makes sense, and repeatedly run the simulation with different inputs until a satisfactory result is achieved. Automating this process is not only of considerable practical importance but will also significantly advance basic artificial intelligence (AI) research in reasoning about the physical world. Author

N92-24424*# International Business Machines Corp., Yorktown Heights, NY. Research Div.
ON CONSTRUCTING THREE-DIMENSIONAL OVERLAPPING GRIDS WITH CMPGRD
William D. Henshaw, Geoffrey Chesshire, and Michael E. Henderson *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 415-434 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

Techniques for the construction of three-dimensional composite overlapping grids, using the grid construction program CMPGRD, are described. The overlapping approach can be used to generate grids for regions of complicated geometry. The grids can be constructed to be smooth and free from coordinate singularities. The ability to create smooth grids for complicated regions is an important first step towards the accurate numerical solution of partial differential equations. The creation of grids for surfaces defined by cross-sections such as an airplane wing is described. A method for integrating the patched surfaces generated by a computer aided design (CAD) package with the CMPGRD program is described. Additionally, the creation of grids in regions where surfaces intersect is described. Author

N92-24425*# Vigyan Research Associates, Inc., Hampton, VA.
RECENT ADVANCES IN UNSTRUCTURED GRID GENERATION PROGRAM VGRID3D
Paresh Parikh and Shahyar Pirzadeh *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 435-448 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

A program for the generation of unstructured grids over complex configurations, VGRID3D, is described. The grid elements (triangles on the surfaces and tetrahedra in the field) are generated starting from the surface boundaries towards the interior of the computational domain using the Advancing Front Method. Author

N92-24426*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THREE-DIMENSIONAL UNSTRUCTURED GRID GENERATION VIA INCREMENTAL INSERTION AND LOCAL OPTIMIZATION
Timothy J. Barth, N. Lyn Wiltberger, and Amar S. Gandhi (MCAT Inst., Moffett Field, CA.) *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 449-461 (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

Algorithms for the generation of 3D unstructured surface and volume grids are discussed. These algorithms are based on incremental insertion and local optimization. The present algorithms are very general and permit local grid optimization based on various measures of grid quality. This is very important; unlike the 2D Delaunay triangulation, the 3D Delaunay triangulation appears not to have a lexicographic characterization of angularity. (The Delaunay triangulation is known to minimize that maximum containment sphere, but unfortunately this is not true lexicographically). Consequently, Delaunay triangulations in three-space can result in poorly shaped tetrahedral elements. Using the present algorithms, 3D meshes can be constructed which optimize a certain angle measure, albeit locally. We also discuss the combinatorial aspects of the algorithm as well as implementational details. Author

N92-24427*# Mississippi State Univ., Mississippi State. National Science Foundation Engineering Research Center.
GEOMETRY MODELING AND MULTI-BLOCK GRID GENERATION FOR TURBOMACHINERY CONFIGURATIONS
Ming H. Shih and Bharat K. Soni *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 463-475 Sponsored by NASA. Lewis Research Center (For primary document see N92-24397 15-61)
Avail: NTIS HC/MF A22 CSCL 09B

An interactive 3D grid generation code, Turbomachinery Interactive Grid genERation (TIGER), was developed for general turbomachinery configurations. TIGER features the automatic generation of multi-block structured grids around multiple blade rows for either internal, external, or internal-external turbomachinery flow fields. Utilization of the Bezier's curves achieves a smooth grid and better orthogonality. TIGER generates the algebraic grid automatically based on geometric information provided by its built-in pseudo-AI algorithm. However, due to the large variation of turbomachinery configurations, this initial grid may not always be as good as desired. TIGER therefore provides graphical user interactions during the process which allow the user to design, modify, as well as manipulate the grid, including the capability of elliptic surface grid generation. Author

N92-24428*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A MULTIBLOCK GRID GENERATION TECHNIQUE APPLIED TO A JET ENGINE CONFIGURATION

Mark E. M. Stewart *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 477-485 (For primary document see N92-24397 15-61)

Avail: NTIS HC/MF A22 CSCL 09B

Techniques are presented for quickly finding a multiblock grid for a 2D geometrically complex domain from geometrical boundary data. An automated technique for determining a block decomposition of the domain is explained. Techniques for representing this domain decomposition and transforming it are also presented. Further, a linear optimization method may be used to solve the equations which determine grid dimensions within the block decomposition. These algorithms automate many stages in the domain decomposition and grid formation process and limit the need for human intervention and inputs. They are demonstrated for the meridional or throughflow geometry of a bladed jet engine configuration. D.R.D.

N92-24429*# Lockheed Engineering and Sciences Co., Hampton, VA.

BATCH MODE GRID GENERATION: AN ENDANGERED SPECIES

David M. Schuster *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 487-500 (For primary document see N92-24397 15-61)

(Contract NAS1-19000)

Avail: NTIS HC/MF A22 CSCL 09B

Non-interactive grid generation schemes should thrive as emphasis shifts from development of numerical analysis and design methods to application of these tools to real engineering problems. A strong case is presented for the continued development and application of non-interactive geometry modeling methods. Guidelines, strategies, and techniques for developing and implementing these tools are presented using current non-interactive grid generation methods as examples. These schemes play an important role in the development of multidisciplinary analysis methods and some of these applications are also discussed. D.R.D.

N92-24430*# Boeing Computer Services Co., Seattle, WA. Aerodynamics Configuration Computing Div.

TECHNIQUE FOR USING A GEOMETRY AND VISUALIZATION SYSTEM TO MONITOR AND MANIPULATE INFORMATION IN OTHER CODES

Thomas P. Dickens *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 501-508 (For primary document see N92-24397 15-61)

Avail: NTIS HC/MF A22 CSCL 09B

A technique was developed to allow the Aero Grid and Paneling System (AGPS), a geometry and visualization system, to be used as a dynamic real-time geometry monitor, manipulator, and interrogator for other codes. This technique involves the direct connection of AGPS with one or more external codes through the use of Unix pipes. AGPS has several commands that control communication with the external program. The external program uses several special subroutines that allow simple, direct communication with AGPS. The external program creates AGPS command lines and transmits the line over the pipes or communicates on a subroutine level. AGPS executes the commands, displays graphics/geometry information, and transmits the required solutions back to the external program. The basic ideas discussed in this paper could easily be implemented in other graphics/geometry systems currently in use or under development. Author

N92-24431*# Mississippi State Univ., Mississippi State.

APPLICATION OF THREE-DIMENSIONAL BEZIER PATCHES IN GRID GENERATION

C. Wayne Mastin *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 509-517 (For primary document see N92-24397 15-61)

(Grant NsG-1577)

Avail: NTIS HC/MF A22 CSCL 09B

Bezier and B-spline patches are popular tools in surface modeling. With these methods, a surface is represented by the tensor product of univariate approximations. The extension of this concept to three-dimensions is obvious and can be applied to the problem of grid generation. This report will demonstrate how three-dimensional patches can be used in solid modeling and in the generation of grids. Examples will be given demonstrating the ability to generate three-dimensional grids directly from a wire frame without having to first set up the boundary surfaces. Many geometric grid properties can be imposed by the proper choice of the control net. D.R.D.

N92-24538*# Intellicorp, Mountain View, CA.

COMPILING KNOWLEDGE-BASED SYSTEMS SPECIFIED IN KEE TO Ada Annual Report, Jul. 1990 - Jun. 1991

Robert E. Filman and Roy D. Feldman Aug. 1991 62 p

(Contract NAS8-38488)

(NASA-CR-190215; NAS 1.26:190215) Avail: NTIS HC/MF A04 CSCL 09B

The first year of the PrKAda project is recounted. The primary goal was to develop a system for delivering Artificial Intelligence applications developed in the ProKappa system in a pure-Ada environment. The following areas are discussed: the ProKappa core and ProTalk programming language; the current status of the implementation; the limitations and restrictions of the current system; and the development of Ada-language message handlers in the ProKappa environment. D.R.D.

N92-24540*# Research Inst. for Computing and Information Systems, Houston, TX.

[REPORTS ON COMPUTER GRAPHICS TESTBED TO SIMULATE AND TEST VISION SYSTEMS FOR SPACE APPLICATIONS] Annual Status Reports

1991 126 p

(Contract NCC9-16; RICIS Proj. AI-02)

(NASA-CR-190276; NAS 1.26:190276) Avail: NTIS HC/MF A07 CSCL 09B

Three reports are presented on computer graphics testbed to simulate and test vision systems for space applications. For individual titles, see N92-24541 through N92-24543.

N92-24541*# Rice Univ., Houston, TX. Dept. of Mechanical Engineering and Materials Science.

COMPUTER GRAPHICS TESTBED TO SIMULATE AND TEST VISION SYSTEMS FOR SPACE APPLICATIONS Annual Report, 15 Oct. 1986 - 15 Oct. 1987

John B. Cheatham, Chris K. Wu, and Y. H. Lin *In* Research Inst. for Computing and Information Systems, Reports on Computer Graphics Testbed to Simulate and Test Vision Systems for Space Applications 1991 108 p Prepared for Research Inst. for

Computing and Information Systems, Houston, TX (For primary document see N92-24540 15-61)
Avail: NTIS HC/MF A07 CSCL 09B

A system was developed for displaying computer graphics images of space objects and the use of the system was demonstrated as a testbed for evaluating vision systems for space applications. In order to evaluate vision systems, it is desirable to be able to control all factors involved in creating the images used for processing by the vision system. Considerable time and expense is involved in building accurate physical models of space objects. Also, precise location of the model relative to the viewer and accurate location of the light source require additional effort. As part of this project, graphics models of space objects such as the Solarmax satellite are created that the user can control the light direction and the relative position of the object and the viewer. The work is also aimed at providing control of hue, shading, noise and shadows for use in demonstrating and testing imaging processing techniques. The simulated camera data can provide XYZ coordinates, pitch, yaw, and roll for the models. A physical model is also being used to provide comparison of camera images with the graphics images. Author

N92-24542*# Rice Univ., Houston, TX. Dept. of Mechanical Engineering and Materials Science.
COMPUTER GRAPHICS TESTBED TO SIMULATE AND TEST VISION SYSTEMS FOR SPACE APPLICATIONS Annual Report, Jul. 1991
John B. Cheatham *In* Research Inst. for Computing and Information Systems, Reports on Computer Graphics Testbed to Simulate and Test Vision Systems for Space Applications 1991 12 p Prepared for Research Inst. for Computing and Information Systems, Houston, TX (For primary document see N92-24540 15-61)
Avail: NTIS HC/MF A07 CSCL 09B

Artificial intelligence concepts are applied to robotics. Artificial neural networks, expert systems and laser imaging techniques for autonomous space robots are being studied. A computer graphics laser range finder simulator developed by Wu has been used by Weiland and Norwood to study use of artificial neural networks for path planning and obstacle avoidance. Interest is expressed in applications of CLIPS, NETS, and Fuzzy Control. These applications are applied to robot navigation. Author

N92-24543*# Rice Univ., Houston, TX. Dept. of Mechanical Engineering and Materials Science.
COMPUTER GRAPHICS TESTBED TO SIMULATE AND TEST VISION SYSTEMS FOR SPACE APPLICATIONS Annual Report, Mar. 1990
John B. Cheatham *In* Research Inst. for Computing and Information Systems, Reports on Computer Graphics Testbed to Simulate and Test Vision Systems for Space Applications 1991 3 p Prepared for Research Inst. for Computing and Information Systems, Houston, TX (For primary document see N92-24540 15-61)
Avail: NTIS HC/MF A07 CSCL 09B

Research activity has shifted from computer graphics and vision systems to the broader scope of applying concepts of artificial intelligence to robotics. Specifically, the research is directed toward developing Artificial Neural Networks, Expert Systems, and Laser Imaging Techniques for Autonomous Space Robots. Author

N92-24548*# Auburn Univ., AL. Dept. of Computer Science and Engineering.
THE DEVELOPMENT OF A PROGRAM ANALYSIS ENVIRONMENT FOR ADA: REVERSE ENGINEERING TOOLS FOR ADA Final Report, 1 Jun. 1990 - 30 Sep. 1991
James H. Cross, II 30 Sep. 1991 218 p
(Contract NCC8-14)
(NASA-CR-190231; NAS 1.26:190231) Avail: NTIS HC/MF A10 CSCL 09B

The Graphical Representations of Algorithms, Structures, and Processes for Ada (GRASP/Ada) has successfully created and prototyped a new algorithm level graphical representation for Ada software, the Control Structure Diagram (CSD). The primary impetus for creation of the CSD was to improve the comprehension efficiency of Ada software and thus improve reliability and reduce costs. The emphasis was on the automatic generation of the CSD from Ada source code to support reverse engineering and maintenance. The CSD has the potential to replace traditional prettyprinted Ada source code. In Phase 1 of the GRASP/Ada project, the CSD graphical constructs were created and applied manually to several small Ada programs. A prototype (Version 1) was designed and implemented using FLEX and BISON running under the Virtual Memory System (VMS) on a VAX 11-780. In Phase 2, the prototype was improved and ported to the Sun 4 platform under UNIX. A user interface was designed and partially implemented. The prototype was applied successfully to numerous Ada programs ranging in size from several hundred to several thousand lines of source code. In Phase 3 of the project, the prototype was prepared for limited distribution (GRASP/Ada Version 3.0) to facilitate evaluation. The user interface was extensively reworked. The current prototype provides the capability for the user to generate CSD from Ada source code in a reverse engineering mode with a level of flexibility suitable for practical application. Author

N92-24677# Oak Ridge National Lab., TN.
THE NETWORK OBSERVER: A USER'S MANUAL AND PROGRAMMER'S GUIDE FOR THE XB CODE
Malcolm R. Patterson and Dan O. Harton Mar. 1992 13 p
(Contract DE-AC05-84OR-21400)
(DE92-009623; ORNL/CSD/TM-285) Avail: NTIS HC/MF A03

A computer program that will yield graphic displays of a variety of statistics simultaneously for 13 emeters has been created. It runs on the SUN computer and uses Dunigan's xtraffic.c code and the xmx code written at Brown University to multiplex these graphs to users at remote sites. By operating in this manner the remote user gets the information without having to query the emeter directly. The emeter is then not overloaded by requests for information, and the operation of the network is more efficient. Current versions of this code operate on the SUN computer and can be extended to other platforms. DOE

N92-24962# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Computer Science.
ASYNCHRONOUS VERSION OF A TERMINATION DETECTION ALGORITHM
H. Saikkonen and S. Roenn 20 May 1991 19 p
(PB92-141852; TKO-A27) Avail: NTIS HC/MF A03 CSCL 09B

The problem of detecting global termination among a number of machines in a network was studied extensively. Several of the proposed algorithms use probing techniques with tokens and presuppose total or partial ordering of the machines in the network. A termination detection algorithm is summarized which, once initialized, records continuously for each machine a lower bound for a simple path to an active machine. As a consequence, the algorithm is more robust than a probing scheme and it can do without the assumption of a total or partial order, but at the cost of more signalling between the machines. This price may be worth paying if the information about the distribution of activity stored in each machine can be used also for other purposes, like routing, etc. The algorithm is presented in two steps. The first version is based on synchronous, CSP-like communication. The second step modifies the first version to work for asynchronous communication as well. This transformation serves also as an example of how similar problems for asynchronous networks can be solved by starting from the simpler, synchronous variant. Author

N92-24969# Grenoble-1 Univ. (France). Lab. de Genie Informatique.
VERIFICATION OF THE PROPERTIES OF SYNCHRONOUS DATA STREAM PROGRAMS Ph.D. Thesis [VERIFICATION DE PROPRIETES DE PROGRAMMES FLOTS DE DONNEES SYNCHRONES]
Anne-Cecile Glory 1989 235 p In FRENCH
(ETN-92-91315) Avail: NTIS HC/MF A11

The critical reactive and real time systems which apply synchronous data stream languages are verified. Special attention is given to properties of safety concerning applications using either SAGA or LUSTRE. The verification method, for which a prototype was developed, consists of evaluating the properties in a model program. A specification language, adapted to the real time reactive systems, is defined. This language contains several time operators. In order to perform an automatic verification, formal semantics of SAGA were defined. Several models were investigated: processing trees, applied as common expression of semantics, graphs of state, and control automates. The use of available verification means, based on the evaluation of the properties in a model program, was evaluated. These methods are related to the time logic trees and to the propositional mu-calculations. A new approach to specify and verify the properties of safety is developed. It consists basically of using the LUSTRE language characteristics. The approach advantages are: a common formulation for programming and specification, the use of the compiler for the verification, and the possibility of modular tests. ESA

N92-25052# Lawrence Livermore National Lab., CA.
STRUCTURAL VISUALIZATION OF COMPLEX SOFTWARE SYSTEMS
V. Vemuri and J. C. Smart (California Univ., Davis.) Aug. 1991 17 p Presented at the 14th International Conference on Software Engineering, Melbourne, Australia, 11-15 May 1992
(Contract W-7405-eng-48)
(DE92-008742; UCRL-JC-108152; CONF-9205122-1) Avail: NTIS HC/MF A03

The design outline of an automatic, computer-based Abstract Visualization Utility (A-Vu) is presented. Although A-Vu is a general purpose tool, emphasis here is on its ability to visualize structural aspects of software design. Starting from a system definition, an Ada program library, or a directed graph definition, A-Vu proceeds to develop a variety of 'nice' linear graphs, revealing different visual representations of the design. Formally, given a linear graph G=(V,E), A-Vu searches for a configuration C such that a suitably defined 'energy' function J(C) is minimized. The definition of the energy function includes software engineering considerations such as layering, modularity as well as aesthetic considerations like visual appeal, cognitive correctness, and so on. Simulated annealing techniques are applied to linear graph representations of software structures to obtain the 'minimum energy' configurations. DOE

N92-25057*# Research Inst. for Computing and Information Systems, Houston, TX.
EXPERT SYSTEM VERIFICATION AND VALIDATION STUDY. ES V/V GUIDELINES/WORKSHOP CONFERENCE SUMMARY
Scott W. French and David Hamilton (International Business Machines Corp., Houston, TX.) 24 Mar. 1992 5 p
(Contract NCC9-16; RICIS Proj. AI-16)
(NASA-CR-190273; NAS 1.26:190273) Avail: NTIS HC/MF A01 CSCL 09B

The intent of the workshop was to start moving research on the verification and validation (V&V) of knowledge based systems (KBSs) in the direction of providing tangible 'products' that a KBS developer could use. In the near term research will focus on identifying the kinds of experiences encountered during KBS development of 'real' KBSs. These will be stored in a repository and will serve as the foundation for the rest of the activities described here. One specific approach to be pursued is 'benchmarking'. With this approach, a KBS developer can use either 'canned' KBSs with seeded errors or existing KBSs with known errors to evaluate a given tool's ability to satisfactorily identify errors. Author

N92-25109# Sandia National Labs., Livermore, CA.
AUTOMATED VISUAL QUALITY EVALUATION OF CVD FILM
W. P. Kegelmeyer, Jr. and F. Hansen 1991 12 p Presented at the International Society for Photo Optical Engineering Conference, Orlando, FL, 20 Apr. 1992
(Contract DE-AC04-76DR-00789)
(DE92-008641; SAND-91-8654C; CONF-920471-2) Avail: NTIS HC/MF A03

This study describes the implementation and performance of a new image analysis algorithm, ALOET, as applied to automatically distinguishing between acceptable and unacceptable chemical vapor deposition (CVD) diamond film. ALOET is a texture feature which measures the homogeneity of the edge orientations in a local window, and which is useful in differentially characterizing large and small polycrystalline structures. The analysis in this study includes a performance metric for film quality evaluation, numerical and visual performance results, and an example analytical model for determining the algorithm's control parameters. DOE

N92-25126# International Centre for Theoretical Physics, Trieste (Italy).
A DYNAMICAL NEWSBOY-TYPE INVENTORY PROBLEM
H. Machado Oct. 1991 9 p
(DE92-619243; IC-91/338) Avail: NTIS HC/MF A02

In stochastic inventory theory the classical newsboy problem constitutes the most investigated basic problem as the stepping-stone to more sophisticated models. Surprisingly some recent work has opened up a few new vistas in the old theme partly out of needs in certain industrial applications of controversies around the standard paradigm, or the desire for more efficient computations or data-fitting methodologies. The report discusses a dynamical stochastic 2-phase model yielding meaningful results, extending some previous work in the area and seemingly amenbable to further developments and applications. DOE

N92-25132# Research Triangle Inst., Research Triangle Park, NC.
MODELING WAVE FORM EFFECTS IN ESPs: THE ALGORITHM IN ESPM AND ESPVI Report, Jun. 1989 - Sep. 1991
P. A. Lawless, N. Plaks, and R. F. Altman 1991 15 p Prepared in cooperation with Electric Power Research Inst., Chattanooga, TN
(Grant EPA-R812281)
(PB92-121243; EPA/600/D-91/258) Avail: NTIS HC/MF A03 CSCL 09B

The ways are detailed in which waveform effects in electrostatic precipitators (ESPs) are modeled. The effects of waveforms on particle charging, space charge corona suppression, and sparking are examined. How the model extend these results to the case of intermittent energization is shown. Electrical energization waveforms were discovered to have an unexpected large role during the development of two ESP programs, ESPM and ESPVI 4.0. The model that predicted lab voltage/current curves superbly gave unacceptably high current densities for large scale ESPs. This is primarily due to the waveforms: pure dc in the lab and pulsating dc in the field. Author

N92-25139*# Nichols Research Corp., Huntsville, AL.
SPIRAL MODEL PILOT PROJECT INFORMATION MODEL
28 Oct. 1991 65 p
(Contract NAS8-37680)
(NASA-CR-184310; NAS 1.26:184310) Avail: NTIS HC/MF A04 CSCL 09B

The objective was an evaluation of the Spiral Model (SM) development approach to allow NASA Marshall to develop an experience base of that software management methodology. A discussion is presented of the Information Model (IM) that was used as part of the SM methodology. A key concept of the SM is the establishment of an IM to be used by management to track the progress of a project. The IM is the set of metrics that is to be measured and reported throughout the life of the project. These metrics measure both the product and the process to ensure the quality of the final delivery item and to ensure the project met programmatic guidelines. The beauty of the SM, along with the IM, is the ability to measure not only the correctness of the specification and implementation of the requirements but to also obtain a measure of customer satisfaction. Author

N92-25145# Technische Univ., Delft (Netherlands).
DYNAMICS OF MECHANICAL SYSTEMS: ALGORITHMS FOR A NUMERICAL INVESTIGATION OF THE BEHAVIOUR OF NON-LINEAR DISCRETE MODELS Ph.D. Thesis
Jacob Philippus Meijaard 1991 150 p Sponsored by Netherlands Organization for Applied Scientific Research TNO
(ETN-92-91299) Avail: NTIS HC/MF A07

Numerical algorithms for the investigation of the behavior of general nonlinear mechanical systems with a limited number of degrees of freedom are described. Systems described by ordinary differential equations that are autonomous or depend explicitly periodically on time, where the behavior in a neighborhood of stationary or periodic solutions is considered, are addressed. Hamiltonian systems and systems with a dihedral symmetry are also discussed. Preliminaries from the theory of dynamical systems are given. Algorithms are described with examples of applications. The application of the algorithms to mechanical systems with discontinuities (a wheelset of a railway vehicle, a friction oscillator, and the dynamics of a section of a drillsting) is described. ESA

N92-24314*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Information Systems Div.
SOFTWARE-ENGINEERING PROCESS SIMULATION (SEPS) MODEL
C. Y. Lin, T. Abdel-Hamid (Naval Postgraduate School, Monterey, CA.), and J. S. Sherif *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 165-185 Prepared in cooperation with California State Univ., Fullerton (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 09B

N92-24325*# Unisys Corp., Huntsville, AL. NASA Structural Analysis Maintenance Group.
NASTRAN INTERNAL IMPROVEMENTS FOR 1992 RELEASE
Gordon C. Chan *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 1-8 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 09B

N92-24326*# Rockwell International Corp., Downey, CA.
EVOLUTION OF A NASTRAN TRAINER
H. R. Grooms, P. J. Hinz, and M. A. Collier *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 9-22 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 09B

N92-24327*# David Taylor Research Center, Bethesda, MD. Computational Signatures and Structures Branch.
ANIMATION OF FINITE ELEMENT MODELS AND RESULTS
Robert R. Lipman *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 23-25 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 09B

N92-24460# MATRA Espace, Toulouse (France).
VERIFICATION TESTS FOR A PROTOTYPE RVD GNC ON-BOARD SOFTWARE
C. Pauvert, J. Tailhades, U. Soppa, F. Kruse, R. Gloerfeld, T. VanOverbeek, and F. Ankersen (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 203-211 (For primary document see N92-24432 15-18)
Copyright Avail: NTIS HC/MF A99

N92-24473# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
ARCHITECTURAL DESIGN OF A TEST ENVIRONMENT FOR AOCS APPLICATIONS
C. Marscholik and U. Schwan (GAUSS G.m.b.H. und Co., Salem, Germany, F.R.) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 305-310 (For primary document see N92-24432 15-18)
Copyright Avail: NTIS HC/MF A99

N92-24484# Fokker Space and Systems, Amsterdam (Netherlands). Attitude Control Dept.
DESIGN AND DEVELOPMENT OF THE SAX-AOCS CONTROL SOFTWARE
Sytze Kampen and Jan Kouwen *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 401-406 (For primary document see N92-24432 15-18)
Copyright Avail: NTIS HC/MF A99

N92-24485# Fokker Space and Systems, Amsterdam (Netherlands).
EXPERIENCES WITH Ada IN ISO-AOCS
P. G. Beerthuizen and M. J. A. Oort *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 407-411 (For primary document see N92-24432 15-18)
Copyright Avail: NTIS HC/MF A99

N92-24486# British Aerospace Public Ltd. Co., Stevenage (England).
SOFTWARE TO SUPPORT ATTITUDE MEASUREMENT SYSTEM DESIGN
Colin Rogers and Roger Lowes *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 413-418 (For primary document see N92-24432 15-18)
Copyright Avail: NTIS HC/MF A99

N92-24487# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Attitude and Orbit Control Section.
OBJECT ORIENTED HARDWARE SIMULATION OF SPACECRAFT CONTROL ALGORITHMS
A. T. Sund, I. Halvorsen, O. Roedseth, B. Foss, and B. Polle (MATRA Espace, Toulouse, France) *In its* Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 419-429 (For primary document see N92-24432 15-18)
Copyright Avail: NTIS HC/MF A99

N92-24488# Dornier System G.m.b.H., Friedrichshafen (Germany, F.R.).
MODE MANAGEMENT AND RUN-TIME-LINKING WITH Ada IN REAL-TIME
R. Gerlich *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 431-436 (For primary document see N92-24432 15-18)
Copyright Avail: NTIS HC/MF A99

N92-24491# Fokker Space and Systems, Amsterdam (Netherlands).
FAULT DETECTION ISOLATION AND RECOVERY WITHIN THE AOCS OF SAX
A. M. Selig (Space Research Organization Netherlands, Utrecht.) and L. Karsten *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 455-459 (For primary document see N92-24432 15-18)
Copyright Avail: NTIS HC/MF A99

N92-24931# Bonn Univ. (Germany, F.R.). Dept. of Computer Science.
EFFICIENT PARALLEL RECOGNITION ALGORITHMS OF COGRAPHS AND DISTANCE HEREDITARY GRAPHS Abstract Only
Elias Dahlhaus *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 127 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N92-24273# Argonne National Lab., IL.
INVESTIGATION OF GOSIP TECHNOLOGY AT ANL
L. Winkler Jan. 1992 42 p
(Contract W-31-109-eng-38)
(DE92-008462; ANL/TM-499) Avail: NTIS HC/MF A03

This document describes testing of OSI products conducted at Argonne National Laboratory. Sun, IBM, and Cisco hardware platforms were used. Various software packages that implement file transfer and gateway applications were evaluated. The OSI model and GOSIP compliance are briefly discussed. Technical details on OSI addressing and routing are presented. The relationship of this testing to other OSI activities at Argonne and to activities of the national networking community is discussed. Mention is also made of the relationship of DECnet Phase 5 transition issues. DOE

N92-24285# Argonne National Lab., IL. Mathematics and Computer Science Div.
SUMMER INSTITUTE IN PARALLEL PROGRAMMING (ORGANIZED BY EWING LUSK AND WILLIAM GROPP)
G. W. Pieper Jan. 1992 9 p Presented at the 1991 Summer Institute in Parallel Programming, Argonne, IL, 3-13 Sep. 1991
(Contract W-31-109-eng-38)
(DE92-008581; ANL/MCS-TM-161; CONF-9109347-Absts) Avail: NTIS HC/MF A02

On September 3 to 13, 1991, Argonne National Laboratory hosted a Summer Institute in Parallel Programming. The institute was organized by the Mathematics and Computer Science Division and was supported in part by the National Science Foundation and by the U.S. Department of Energy. The objective of the institute was to familiarize graduate students and postdoctoral researchers with new methods and tools for parallel programming and to provide hands-on experience with a diverse array of advanced-computer architectures. This report summarizes the activities that took place during the ten-day institute. DOE

N92-24695*# Computational Logic, Inc., Austin, TX.
MECHANICALLY VERIFIED HARDWARE IMPLEMENTING AN 8-BIT PARALLEL IO BYZANTINE AGREEMENT PROCESSOR
J. Strother Moore 1992 41 p
(Contract NAS1-18878)
(NASA-CR-189588; NAS 1.26:189588; TR-69) Avail: NTIS HC/MF A03 CSCL 09B

Consider a network of four processors that use the Oral Messages (Byzantine Generals) Algorithm of Pease, Shostak, and Lamport to achieve agreement in the presence of faults. Bevier and Young have published a functional description of a single processor that, when interconnected appropriately with three identical others, implements this network under the assumption that the four processors step in synchrony. By formalizing the original Pease, et al work, Bevier and Young mechanically proved that such a network achieves fault tolerance. We develop, formalize, and discuss a hardware design that has been mechanically proven to implement their processor. In particular, we formally define mapping functions from the abstract state space of the Bevier-Young processor to a concrete state space of a hardware module and state a theorem that expresses the claim that the hardware correctly implements the processor. We briefly discuss the Brock-Hunt Formal Hardware Description Language which permits designs both to be proved correct with the Boyer-Moore theorem prover and to be expressed in a commercially supported hardware description language for additional electrical analysis and layout. We briefly describe our implementation. Author

N92-25043# Fermi National Accelerator Lab., Batavia, IL.
HIGH PERFORMANCE PARALLEL LOCAL MEMORY COMPUTING AT FERMILAB
T. Nash Jan. 1992 6 p Presented at the WHP92 on Heterogeneous Processing, Beverly Hills, CA, 23 Mar. 1992
(Contract DE-AC02-76CH-03000)
(DE92-008249; FNAL/C-92/13; CONF-920390-1) Avail: NTIS HC/MF A02

Both experimental and theoretical approaches to high energy physics (HEP) at Fermilab are computer technology limited: no one can identify a requirement on computing or data capacity that is independent of cost or other realities. Fermilab has been forced, therefore, to turn significant attention and resources to finding extremely cost effective solutions to its computing using whatever technology is available, and in the process has become a pioneer in goal-driven computer science, integrating commercial solution at the chip, board, and system level. In recent years, most obviously first in the hypercube movement, and now in the surge of interest in networked parallel workstation 'clusters', explicit parallelism has become a recognized force in the computer science attack on the problem of parallel computing. The report discusses the implementation of these computer systems. DOE

N92-24356# Bonn Univ. (Germany, F.R.). Inst. fuer Radioastronomie.
DAN: COMPUTER NETWORK FOR THE IMAGE PROCESSING OF SATELLITE DATA [DAN: DEUTSCHES ASTRO-NETZ]
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 27-28 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N92-24214# Helsinki Univ. of Technology, Espoo (Finland). Automation Technology Lab.
REVISED PAPERS OF THE LICENTIATE SEMINAR ON INTELLIGENT AUTONOMOUS MOBILE ROBOTS
A. Halme and A. Visala Jan. 1990 106 p Seminar held in Espoo, Finland, Spring, 1988
(PB92-142314; ISBN-951-22-0134-8; SER-B-4) Avail: NTIS HC/MF A06 CSCL 09B

The survey gives a comprehensive view of the structure and functions of the control systems of intelligent mobile robots. A short overview is given of the history of mobile robots, and the general structure is presented. The perception processing section includes material on proximity, inertial and other sensors, different kinds of vision and range imaging systems, and sensor function. Different ways to model the environment are presented. Navigation and supervision tasks are analyzed and different kinds of solutions are described. Applications and future trends are forecast. Author

N92-24219# Technische Univ., Twente (Netherlands). Faculty of Applied Mathematics.
COMPLEMENTS TO NONLINEAR H INFINITY OPTIMAL CONTROL BY STATE FEEDBACK
A. J. vanderSchaft Aug. 1991 17 p
(PB92-148691; Memo-991) Avail: NTIS HC/MF A03 CSCL 09B

Two extensions to previously obtained results on nonlinear H sub infinity control are given. The first extension is concerned with the finite horizon version of the H sub infinity problem, while the second extension deals with the nonlinear systems which are not necessarily linear in the input and where the variables to be regulated are of a more general nature than they were once considered to be. Author

N92-24245*# National Aeronautics and Space Administration. Pasadena Office, CA.
GaAs-BASED OPTOELECTRONIC NEURONS Patent Application
Steven H. Lin, inventor (to NASA), Jae H. Kim, inventor (to NASA), and Demetri Psaltis, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 3 Mar. 1992 21 p
(Contract NAS7-918)
(NASA-Case-NPO-18497-1-CU; NAS 1.71:NPO-18497-1-CU; US-Patent-Appl-SN-845283) Avail: NTIS HC/MF A03 CSCL 09B

An integrated, optoelectronic, variable thresholding neuron implemented monolithically in GaAs integrated circuit and exhibiting high differential optical gain and low power consumption is presented. Two alternative embodiments each comprise an LED monolithically integrated with a detector and two transistors. One of the transistors is responsive to a bias voltage applied to its gate for varying the threshold of the neuron. One embodiment is implemented as an LED monolithically integrated with a double heterojunction bipolar phototransistor (detector) and two metal semiconductor field effect transistors (MESFET's) on a single GaAs substrate and another embodiment is implemented as an LED monolithically integrated with three MESFET's (one of which is an optical FET detector) on a single GaAs substrate. The first noted embodiment exhibits a differential optical gain of 6 and an optical switching energy of 10 pJ. The second embodiment has a differential optical gain of 80 and an optical switching energy of 38 pJ. Power consumption is 2.4 and 1.8 mW, respectively. Input 'light' power needed to turn on the LED is 2 mW and 54 nW, respectively. In both embodiments the detector is in series with a biasing MESFET and saturates the other MESFET upon detecting light above a threshold level. The saturated MESFET turns on the LED. Voltage applied to the biasing MESFET gate controls the threshold. NASA

N92-24698# Allied-Signal Aerospace Co., Kansas City, MO.
ROBOTIC 3D VISION SOLDER JOINT VERIFICATION SYSTEM EVALUATION
M. A. Trent Feb. 1992 39 p
(Contract DE-AC04-76DP-00613)
(DE92-008502; KCP-613-4656) Avail: NTIS HC/MF A03

A comparative performance evaluation was conducted between a proprietary inspection system using intelligent 3D vision and manual visual inspection of solder joints. The purpose was to assess the compatibility and correlation of the automated system with current visual inspection criteria. The results indicated that the automated system was more accurate (greater than 90 pct.) than visual inspection (60 to 70 pct.) in locating and/or categorizing solder joint defects. In addition, the automated system can offer significant capabilities to characterize and monitor a soldering process by measuring physical attributes, such as solder joint volumes and wetting angles, which are not available through manual visual inspection. A more in-depth evaluation of this technology is recommended. DOE

N92-24423*# Rutgers - The State Univ., New Brunswick, NJ. Dept. of Computer Science.
USING ARTIFICIAL INTELLIGENCE TO CONTROL FLUID FLOW COMPUTATIONS
Andrew Gelsey *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 401-413 (For primary document see N92-24397 15-61)
(Grant NAG2-645)
Avail: NTIS HC/MF A22 CSCL 09B

N92-24989*# National Inst. of Standards and Technology, Gaithersburg, MD. Manufacturing Engineering Lab.
INTELLIGENT PROCESSING EQUIPMENT RESEARCH AND DEVELOPMENT PROGRAMS OF THE DEPARTMENT OF COMMERCE
J. A. Simpson *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 20-31 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 09B

N92-24990*# Department of Energy, Washington, DC.
US DEPARTMENT OF ENERGY'S EFFORTS IN INTELLIGENT PROCESSING EQUIPMENT
Richard D. Peavy and Janet C. McFarland (Meridian Corp., Alexandria, VA.) *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 32-54 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 09B

N92-24991*# Wright Lab., Wright-Patterson AFB, OH. Manufacturing Technology Directorate.
AN INTRODUCTION TO INTELLIGENT PROCESSING PROGRAMS DEVELOPED BY THE AIR FORCE MANUFACTURING TECHNOLOGY DIRECTORATE
Paul G. Sampson and Linda C. Sny *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 55-62 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 09B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N92-24215# Helsinki Univ. of Technology, Espoo (Finland). Inst. of Mathematics.
SOBOLEV CHARACTERIZATION OF SOLUTIONS OF DILATION EQUATIONS
T. Eirola Mar. 1991 26 p
(PB92-141514; RR-A292; ISBN-951-22-0538-6) Avail: NTIS HC/MF A03 CSCL 12A

Studied here is the smoothness of the solutions of dilation equations which are encountered in the multiresolution analysis and iterative interpolation processes. A sharp limit of the Sobolev exponent of the solution is given as a function of the spectral radius of an associated finite dimensional positive operator. In addition, tools are given to get good explicit upper and lower bounds for the exponent. Author

N92-24216# Helsinki Univ. of Technology, Espoo (Finland). Inst. of Mathematics.
QUASINILPOTENCY OF THE OPERATORS IN PICARD-LINDELOF ITERATION
U. Miekkala and O. Nevanlinna Aug. 1991 31 p
(PB92-141795; RR-A298; ISBN-951-22-0753-2) Avail: NTIS HC/MF A03 CSCL 12A

The superlinear convergence of Picard-Lindelof iteration on finite time intervals is studied by considering the resolvent as an operator-valued entire function. The main conclusions are related to the following fact: the convergence properties of the iteration when applied to a large and sparse system are largely determined by the graph properties of the decomposition and are partly insensitive in terms of the values of the elements of the matrices. Author

N92-24217# Helsinki Univ. of Technology, Espoo (Finland). Inst. of Mathematics.
NOTE ON POLYNOMIAL APPROXIMATION ON CANTOR-TYPE SETS OF CAPACITY ZERO
O. P. Piirilae Oct. 1991 16 p
(PB92-143288; RR-A302; ISBN-951-22-0825-3) Avail: NTIS HC/MF A03 CSCL 12A

Estimates for the rate of the decay of the Chebyshev numbers are derived for a family of Cantor sets. The result is given in the form of a sharpened version of a well-known criterion for such sets to be of capacity zero. The estimate is used as a model example of polynomial acceleration of linear iterative processes involving operators L with cap(sigma(L)) = 0. Author

N92-24218# Helsinki Univ. of Technology, Espoo (Finland). Inst. of Mathematics.
ASPECTS OF BACKWARD ERROR ANALYSIS IN NUMERICAL ODE'S
T. Eirola Nov. 1991 14 p
(PB92-143296; RR-A303; ISBN-951-22-0840-7) Avail: NTIS HC/MF A03 CSCL 12A

Some preliminary cases are studied to see how the idea of backward error analysis carries over to numerical solution of ordinary differential equations. The interest here is in one-step methods and infinite time intervals. Author

N92-24220# Technische Univ., Twente (Netherlands). Faculty of Applied Mathematics.
PASSIVE SYSTEMS: FROM LINEARITY TO NONLINEARITY
R. Ortega, H. Nijmeijer, and A. C. Ruiz Sep. 1991 17 p
Prepared in cooperation with McGill Univ., Montreal, Quebec
Sponsored in part by Consejo Nacional de Ciencia y Tecnologia, Mexico City, Mexico
(PB92-148733; Memo-995) Avail: NTIS HC/MF A03 CSCL 12A

Studied here is the problem of where the passivity of a nonlinear system can be inferred from the associated first order approximation. The conditions under which a nonlinear system can be made passive via static state feedback once the linearized system is assumed to have the property is analyzed. Also analyzed is the case of a linear controller which leaves the linearized system passive, preserving similar input-output properties when applied to the nonlinear plant. Author

N92-24259# International Centre for Theoretical Physics, Trieste (Italy).
GLOBAL SOLVABILITY AND HYPOELLIPTICITY ON THE TORUS FOR A CLASS OF DIFFERENTIAL OPERATORS WITH VARIABLE COEFFICIENTS
T. Gramchev, P. Popivanov, and M. Yoshino (Chuo Univ., Tokyo, Japan) Jul. 1991 13 p
(DE92-615228; IC-91/190) Avail: NTIS HC/MF A03

The present paper studies global hypoellipticity and global solvability on the two dimensional torus T(sup 2) for a class of second order differential operators with variable coefficients of the type P=(D sub x)-ia(x)D sub y) (D sub x)-ib(x)D sub y)+(a'(x)-b'(x))D sub y+c(x). Necessary and/or sufficient conditions for global solvability and global hypoellipticity are proposed. In particular if Rea(x) (identical to) 0 and/or Reb(x) (identical to) 0 Siegel type conditions on the diophantine approximation of the averages (integral)(sub 0)(sup 2(pi))Rea(x)dx and/or (integral)(sub 0)(sup 2(pi))Reb(x)dx occur. We also indicate some results for more general class of operators and for the n-dimensional torus T(sup n), n greater than 2. DOE

N92-24262# International Centre for Theoretical Physics, Trieste (Italy).
HARMONIC ANALYSIS AND GLOBAL SOLVABILITY OF A DIFFERENTIAL OPERATOR INVARIANT ON MOTION GROUPS AND SEMI-SIMPLE LIE GROUPS
K. El-Hussein Aug. 1991 40 p In FRENCH; ENGLISH summary
(DE92-615231; IC-91/236) Avail: NTIS HC/MF A03

Let V be a real finite dimensional vector space and let K be a connected compact Lie group, which acts on V by means of a continuous linear representation (rho). Let G = V x(sub p) K be the motion group which is the semi-direct product of V by K and let P be an invariant differential operator on G. In this paper we give a necessary and sufficient condition for the global solvability of P on G. Now let G be a connected semi-simple Lie group with finite center and let P be an invariant differential operator on G. We give also a necessary and sufficient condition for the global solvability of P on G. DOE

N92-24263# International Centre for Theoretical Physics, Trieste (Italy).
STRONG DENSITY OF A CLASS OF SIMPLE OPERATORS
S. Somasundaram and N. Mohammad Aug. 1991 9 p
(DE92-615232; IC-91/237) Avail: NTIS HC/MF A02

An algebra of simple operators has been shown to be strongly dense in the algebra of all bounded linear operators on function spaces of a compact (not necessarily abelian) group. Further, it is proved that the same result is also true for L(sup 2)(G) if G is a locally compact (not necessarily compact) abelian group. DOE

N92-24265# International Centre for Theoretical Physics, Trieste (Italy).
CHARACTERIZATIONS OF LOCALLY C(SUP *)-ALGEBRAS
N. Mohammad and S. Somasundaram Aug. 1991 10 p
(DE92-615234; IC-91/245) Avail: NTIS HC/MF A02

We seek the generalization of the Gelfand-Naimark theorems for locally C*-algebras. Precisely, if A is a unital commutative locally C*-algebra, then it is shown that A is *-isomorphic (topologically and algebraically) to C(Delta). Further, if A is any locally C*-algebra, then it is realized as a closed *-subalgebra of some L(H) up to a topological algebraic *-isomorphism. Also, a brief exposition of the Gelfand-Naimark-Segal construction is given and some of its consequences are discussed. DOE

N92-24275# International Centre for Theoretical Physics, Trieste (Italy).
AN ESTIMATE OF THE DIFFERENCE BETWEEN CONSECUTIVE EIGENVALUES
Hong-Cang Yang Apr. 1991 8 p
(DE92-615236; IC-91/60) Avail: NTIS HC/MF A02

Starting from the classical result obtained by Payne, Polya and Weinberger on the estimate of the difference between two consecutive eigenvalues, an attempt is made to improve these estimates. DOE

N92-24278# International Centre for Theoretical Physics, Trieste (Italy).
ROTATIONAL-ISOTOPIC SYMMETRIES
R. M. Santilli Sep. 1991 16 p
(DE92-615259; IC-91/261) Avail: NTIS HC/MF A03

In this note, we submit a nonlocal (integral) generalization of the rotational-isotopic symmetries O-circumflex(3) introduced in preceding works for nonlinear and nonhamiltonian systems in local approximation. By recalling that the Lie-isotopic theory naturally admits nonlocal terms when all embedded in the isounit, while the conventional symplectic geometry is strictly local-differential, we introduce the notion of symplectic-isotopic two-forms, which are exact symplectic two-forms admitting a factorization into the Kronecker product of a canonical two-form time the isotopic element of an underlying Euclidean-isotopic space. Topological consistency is then achieved by embedding all nonlocal terms in the isounit of the iso-cotangent bundle, while keeping the local topology for the canonical part. In this way, we identify the symplectic-isotopic geometry as being the natural geometrical counterpart of the Lie-isotopic theory. The results are used for the introduction of the notion of Birkhoffian angular momentum, that is, the generalization of the conventional canonical angular momentum which is applicable to Birkhoffian systems with generally nonlinear, nonlocal and nonhamiltonian internal forces. The generators J (and the parameters (theta)) coincide with the conventional quantities. Nevertheless, the quantity J is defined on the underlying Euclidean-isotopic space, by therefore acquiring a generalized magnitude. The isocommutation rules and isoexponentiation of the Birkhoffian angular momentum are explicitly computed and shown to characterize the most general known nonlinear and nonlocal realization of the isorotational symmetry. The local isomorphisms between the infinitely possible isotopes O-circumflex(3) and the conventional symmetry O(3) is proved. Finally the isosymmetries O-circumflex(3) are used to characterize the conserved, total, Birkhoffian angular momentum of closed nonselfadjoint systems. DOE

N92-24350*# Mississippi State Univ., Mississippi State.
APPLICATION OF THREE-DIMENSIONAL BEZIER PATCHES IN GRID GENERATION
C. Wayne Mastin 1990 9 p
(Grant NsG-1577)
(NASA-CR-189000; NAS 1.26:189000) Avail: NTIS HC/MF A02 CSCL 12A

Bezier and B-spline patches are popular tools in surface modeling. With these methods, a surface is represented by the tensor product of univariate approximations. The extension of this concept to three dimensions is obvious and can be applied to the problem of grid generation. This report will demonstrate how three dimensional patches can be used in solid modeling and in the generation of grids. Examples will be given demonstrating the ability to generate three dimensional grids directly from a wire frame without having to first set up the boundary surfaces. Many geometric grid properties can be imposed by the proper choice of the control net. Author

N92-24903# Helsinki Univ. of Technology, Espoo (Finland). Systems Analysis Lab.
SUFFICIENT CONDITIONS FOR THE EXISTENCE OF MULTIPLIERS AND LAGRANGIAN DUALITY IN ABSTRACT OPTIMIZATION PROBLEMS
E. V. Tamminen Nov. 1991 19 p Prepared in cooperation with Technical Research Centre of Finland, Espoo
(PB92-151471; ISBN-951-22-0853-9; A-41) Avail: NTIS HC/MF A03 CSCL 12A

The following optimization problem is considered: in an abstract set X find an element x that minimizes a real function f subject to constraints g(x) less than or equal to 0 and h(x) equals 0, where g and h are functions from X into normed vector spaces. Assumptions concerning an overall convex structure for the problem in the image space, the existance of interior points in certain sets, and the normality of the constraints are formulated. A theorem of the alternative is proved for systems of equalities and inequalities, and an intrinsic multiplier rule. A Lagrangian saddle point theorem (a strong duality theorem) is obtained as a consequence. Author

N92-24905# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
SECOND TWENTE WORKSHOP ON GRAPHS AND COMBINATORIAL OPTIMIZATION
U. Faigle, ed. and C. Hoede, ed. May 1991 155 p Workshop held in Twente, Netherlands, 22-24 May 1991
(MEMO-964; ISSN-0169-2690; ETN-92-91039) Avail: NTIS HC/MF A08

Extended abstracts and abstracts on the subject of graphs and combinatorial optimization are presented. For individual titles, see N92-24906 through N92-24955.

N92-24906# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
THE FUSION OF GRAPH THEORY AND COOPERATIVE GAME THEORY: THE CASE OF MINIMUM COST SPANNING TREE GAMES
Harry Aarts and Theo Driessen *In its* Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 5-8 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A game theoretic approach to the cost allocation problem of setting charges for the users (house owners) in an electricity network with one common supplier (electric company) is presented. The relevant game theoretic model is described in terms of an appropriate game in characteristic function form which is derived from the underlying electricity network. The notion of a network is described by the complete graph with node set and undirected edge set and a nonnegative function on the edge set. Two theorems on minimum costspanning tree games and one theorem on a convex game are described. ESA

N92-24907# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
A CLASS OF PERFECT GRAPHS
S. M. Baas *In its* Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 9-12 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Using properties regarding a minimal imperfect graph, a certain class of simple (loopless and undirected) graphs is proved to be perfect. Notations are introduced in order to specify this class and a class of semidense graphs is defined. A theorem which proves that the class of semidence graphs is perfect is given. ESA

N92-24908# Paedagogische Hochschule, Dresden (Germany, F.R.). Inst. fuer Mathematik und Ihre Didatik.
HAMILTONIAN CYCLES IN TRIVALENT CAYLEY GRAPHS
Ulrike Baumann *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 13-19 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

The investigation of the class of trivalent Cayley graphs is especially interesting since these Cayley graphs are most likely to be non-Hamiltonian because of their small number of edges. It was previously proved that every trivalent Cayley graph of a dihedral group D(sub n) (n less than 120) has a Hamiltonian cycle. A study in which Hamiltonian cycles in trivalent Cayley graphs of a larger class of dihedral groups are constructed is presented. ESA

N92-24909# Kiel Univ. (Germany, F.R.). Inst. fuer Mathematik.
ON MINOR-MINIMAL GRAPHS
R. Bodendiek *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 20-23 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Concepts of minor minimal graphs and minimal bases are introduced, and an attempt is made to develop a method of determining the elements on the minimal basis M(2) of the projective plane N(2) which does not use Klein bottle N(2). It was previously proved that there exists a method for B(2) which does not use B(2) and enables M(2)(B(2)) to be determined without using B(2). The aim is to represent this method with the hope of finding a corresponding method for M(2)(N(2)). It turns out that the subset of all greater than 2 minimal graphs of connectivity less than or equal to 2 in M(2)(B(2)) consists of exactly 12 elements. The holding theorems are given. ESA

N92-24910# Fern Univ., Hagen (Germany, F.R.). Theor. Informatik.
SHORT DISJOINT CYCLES IN CUBIC BRIDGELESS GRAPHS
Andreas Brandstaedt *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 24-31 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Cubic bridgeless graphs with n vertices are shown to have Omega (n to the 1/7 power) pairwise disjoint cycles of length Omicron (n to the 6/7 power). As a consequence, the girth of bridgeless graphs whose vertex degree is 2 or 3 and at most one half of the vertices have degree 2, is bounded by Omicron (n to the 6/7 power) - a omicron(n). This is useful in solving the bisection problem (configuring transputer systems) for regular graphs of degree 4. ESA

N92-24911# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
LONG CYLES, DEGREE SUMS, AND NEIGHBORHOOD UNIONS
H. J. Broersma, J. vandenHeuvel, and H. J. Veldman *In its* Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 32-37 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Theorems and corollaries considering simple graphs only are presented. An introduction relating to long cycles, degree sums and neighborhood unions of graph theory is given. Generalizations of given theorems are stated which also imply known results not contained in the theorems. ESA

N92-24912# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
THE CONNECTIVITY OF TWO TYPES OF LEAF-EXCHANGE SPANNING TREE GRAPHS
Hajo Broersma and Li Xueliang (Xinjiang Univ., Urumchi, China) *In its* Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 38-42 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A variation of the leaf exchange spanning tree graph appeared in recent work on basis graphs of branching greedoids. In these graphs all spanning tree have a common root vertex. The graphs which have a connected leaf exchange spanning trees graph are characterized and a lower bound on the connectivity of T(sub l)(G) for a 3 connected graph G is given. A lower bound in the connectivity of the basis graph of a 3 connnected branching greedoid, is also given. ESA

N92-24913# Friedrich-Schiller Univ., Jena (German D.R.). Sektion Mathematik.
PLA FOLDING IN SPECIAL GRAPH CLASSES
Peter Damaschke *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 43-47 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

NP completeness results and the dynamic programming approach for block folding and polynomial results for variable folding are discussed and theorems are given. Folding problems have a serious application in the minimization of physical area of Programmed Logic Arrays (PLAs). PLAs are circuits of simple regular structure which compute suitable Boolean functions given in Disjunctive or Conjunctive Normal Form (DNF or CNF). To every Boolean formula in DNF or CNF, a so called incompatibility graph can be related. Both folding problems are NP hard. Results from referenced investigations are outlined and the complexity of folding for a number of 'standard' graph classes considered is investigated. ESA

N92-24914# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
A TINNED IRON PURCHASING PROBLEM
B. Dorhout *In its* Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 48-52 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A purchasing problem originating from a large tin factory, the way it was solved, and possible improvements of the approach, are described. The problem concerns the minimization of purchase costs for a fixed production program. This can be achieved by earning quantity discounts and by choosing rectangular iron sheets of greater width than needed, exploiting the price structure. A combinatorial programming model of the described problem was formulated and a program was made for its solution on a microcomputer. ESA

N92-24915# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
GREEDY k-DECOMPOSITION OF INTERVAL ORDERS
U. Faigle and W. M. Nawijn *In its* Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 53-56 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A study which points out that for (partial) interval orders P a last fit greedy algorithm constructs an optimal k decomposition very efficiently if it is applied according to an N maximal decomposition ordering of P, is presented. An informal description of the algorithm is given. The correctness of the algorithm is discussed. ESA

N92-24916# Technische Hochschule, Ilmenau (German D.R.). Inst. fuer Mathematik.
A LOWER BOUND FOR THE SHORTNESS COEFFICIENT OF A CLASS OF GRAPHS
J. Harant and H. Walther *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 57-64 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A graph G with its vertex set V(G) and its edge set E(G) is taken to be a finite connected undirected graph without loops and multiple edges. For P, Q belongs to V(G), the number d(P,Q) is the length of a shortest path connecting P and Q in G. Theorems for a lower bound for the shortness coefficient are investigated. ESA

N92-24917# Universite des Sciences et Techniques du Languedoc, Montpellier (France). Centre de Recherche en Informatique.
COMPUTING THE JUMP NUMBER IN SEMI-ORDERS IS POLYNOMIAL
C. delaHiguera *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 65-72 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Semi orders form a subclass of internal orders: they can be represented as sets of intervals of a given length. It is proved that semi order can be partitioned by serialization (or series decomposition) without loss of the jump number aspect. On non serializable semi orders, all linear extensions contain never more than two consecutive bumps (maximum chains of length at most 3). A 'divide and conquer' argument is given, proving that to solve this case all that is needed is to solve the case where the length of maximal chains is limited by 2. This can also be dealt with in polynomial time by a maximum matching technique, allowing the claim that computing the jump number is polynomial on semi orders. ESA

N92-24918# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
PLANAR GRAPH AUGMENTATION PROBLEMS
Goos Kant and Hans L. Bodlaender *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 73-80 (For primary document see N92-24905 15-64) (Contract EEC-3075)
Avail: NTIS HC/MF A08

The problem of adding a minimum number of edges to a planar graph, in such a way that the resulting graph is biconnected and still planar, is investigated. This problem is shown to be NP complete. An approximation algorithm for this planar biconnectivity problem that has performance ratio 3/2 and uses O(n squared log n) time is presented. An O(n to the 2.5 power) approximation algorithm is presented to make a biconnected planar graph triconnected by adding edges without losing planarity, that has a performance ratio of 6/5. Some auxilliary results for augmenting special classes of planar graphs are included. ESA

N92-24919# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
SCHEDULING MULTI-OPERATION JOBS WITH TIME LAGS ON A SINGLE MACHINE
W. Kern and W. N. Nawijn *In its* 2nd Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 81-86 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A simple variant of single machine sequencing problems is discussed. There are jobs to be processed in a single machine. Each job requires two operations to be processed in a given order. The time between the start of the second operation and the completion time of the first operation cannot be less than a prespecified time constant, i.e., there exists a minimal time lag

between the two operations of the same job. The aim is to minimize the makespan, i.e., the completion time of the second operation of the last job in the schedule. The general model is considered and the problem is proved to be NP hard. Some subproblems are considered. In particular, it is shown that the problem with constant time lags can be solved using Johnson's algorithm for the n/2/F/F(maximum) flow shop problem. ESA

N92-24920# Friedrich-Schiller Univ., Jena (German D.R.). Matematische Fakultaet.
THE RECOGNITION OF GRID GRAPHS IS NP-COMPLETE
Haiko Mueller *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 87-94 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

The NP completeness of the problem to decide whether a tree is a grid graph or an induced grid graph respectively is shown. The method is a standard component design reduction from the well known NP complete problem of satisfiability. ESA

N92-24921# Fern Univ., Hagen (Germany, F.R.). Fachgebiet Kommunikationssysteme.
RELIABILITY OF NETWORKS USING STATIC ROUTING c32
Werner Poguntke *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 95-99 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Communication networks where messages are routed according to the following rule are considered: each node keeps an ordered list of neighboring nodes, for each possible destination node; if a message (packet) carrying node Z as destination address has to be routed by node X, than X sends the message to the first available neighbor on its list for Z. Given an unidirected graph G modeling the nodes and links of the network, the collection of all the lists is called a 'routing plan'. The problem is to devise the routing plan such that several performance criteria are met. Loop freeness, use of short routes, bidirectionality, even load distribution and high reliability are among the most important criteria. It turns out that these criteria are in conflict with each other. In particular, there are graphs that do not allow routing plans which are loop free and bidirectional. ESA

N92-24922# Universite Blaise Pascal, Aubiere (France). Lab. d'Informatique.
AN INTERVAL DECOMPOSITION METHOD FOR SOLVING A RESOURCE AFFECTATION PROBLEM
A. Quilliot and Xiao-Chao Sun *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 100-107 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

The following data is considered: X is an action set; M is a resource set; T is a multiapplication from X to M which, for any x in X, defines the subset T(x) of M of the resources of M which are compatible with x; H is a triplet (F, Min, Max) where F is a family of subset of M and Min, Max are functions from F to the natural number set. An affection of the actions of X to the resources of M is said to be H compatible if for every f in F: Min(f) equal to less than number of actions of X affected on resources of f equal to less than Max(f). Searching for a H compatible affectation (eventually optimal in relation with a given criterion) defines a problem which may be frequently encountered in timetabling conception, scheduling band plan, construction and which is most often Time-NP-Complete (as far as the cardinality of M is taken into account inside the complexity calculus). It is proved that if F may be represented as an interval family, then the H compatible affectation problem can be solved by relaxation of the associated integer linear problem, and from this a decomposition method for solving the general case is deduced. ESA

N92-24923# Friedrich-Schiller Univ., Jena (German D.R.). Inst. fuer Angewandte und Technische Informatik.
CHROMATICAL NUMBER OF PRIME DISTANCE GRAPHS
M. Voigt and H. Walther (Technische Hochschule, Ilmenau, German D.R.) *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 108-111 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

The problem of characterizing all prime distance graphs with the chromatic number 3 is addressed. A theorem which helps in investigating the consistency of 3-colorings is given. This theorem with a given construction of colorings is used to prove the main result. ESA

N92-24924# Technische Hochschule, Aachen (Germany, F.R.). Lehrstuhl fuer Mathematik.
ON GRAPHS WITH EQUAL DOMINATION AND COVERING NUMBERS
Lutz Volkmann *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 112-119 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A set D of vertices of a simple graph G is dominating if every vertex not in D is adjacent to some vertex in D, and is covering if every edge of G has at least one end in D. The domination number gamma(G) is the minimum order of a dominating set in G. The covering number beta(G) is the minimum order of a covering set in G. Different graphs for which gamma(G) = beta(G) are characterized. ESA

N92-24925# Academy of Mining and Metallurgy, Cracow (Poland). Inst. Matematyki.
EMBEDDING GRAPHS OF SMALL SIZE
Mariusz Wozniak *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 120-124 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Theorems on embedding of graphs are presented. Standard graph theory notation is used. A finite, unidirected graph G consists of a vertex set V(G) and edge set E(G). All graphs are assumed to have neither loops nor multiple edges. ESA

N92-24926# Stevens Inst. of Tech., Hoboken, NJ. Dept. of Pure and Applied Mathematics.
TOUGHNESS, MINIMUM DEGREE, AND THE EXISTENCE OF 2-FACTORS Abstract Only
D. Bauer and E. Schmeichel (San Jose State Univ., CA.) *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 125 (For primary document see N92-24905 15-64)
(Contract MDA904-H-89-2008; NSF DMS-89-04520)
Avail: NTIS HC/MF A08

Degree conditions on the vertices of a t tough graph (t is greater than or equal to 1 and less than or equal to 2) which ensure the existence of a 2 factor in G are presented. These conditions are asymptotically best possible for every t a member of the closed interval set (3/2, 2). ESA

N92-24927# Paedagogische Hochschule, Dresden (Germany, F.R.). Inst. fuer Mathematik.
HAMILTONIAN CYCLES IN TRIVALENT CAYLEY GRAPHS Abstract Only
Ulrike Baumann *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 125 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

The question of whether there are Cayley graphs without Hamiltonian cycles is addressed. It is interesting to consider trivalent Cayley graphs since they are the simplest nontrivial Cayley graphs which could be nonHamiltonian. The graphs considered are trivalent Cayley graphs. ESA

N92-24928# Kiel Univ. (Germany, F.R.). Inst. fuer Mathematik.
ON MINOR-MINIMAL GRAPHS Abstract Only
R. Bodendiek *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 126 (For

primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Let gamma be the Klein bottle N(2) or the spindle surface B(2) arising from a torus by contracting two different meridians to a single point, each. Since the number of minor-minimal graphs in the set gamma (N(2)) of all graphs which do not embed in N(2) is relatively great, the development of a method of determining minor-minimal graphs in gamma(N(2)) by generalizing the method of giving the minor-minimal graphs in gamma(B(2)) (the set of all graphs not embeddable in B(2)) is desired. A short sketch of this method shows the great advantage of this method which does not need the surface B(2). ESA

N92-24929# Utrecht State Univ. (Netherlands). Dept. of Computer Science.
THE COMPLEXITY OF COLORING GAMES ON PERFECT GRAPHS Abstract Only
Hans L. Bodlaender and Dieter Kratsch (Friedrich-Schiller Univ., Jena, German D.R.) *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 126 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

The following type of game is considered: two players must color the vertices of a given graph G = (V,E), in a predescribed order, such that no two adjacent vertices are colored with the same color. In one variant, the first player unable to move loses the game. In another variant, player 1 wins the game, if and only if the game ends with all vertices colored. Several results are obtained on the complexity of the problem to decide whether there is a winning strategy for player 1 in a given game instance, when G is restricted to split graphs, interval graphs, or bipartite graphs. ESA

N92-24930# Tilburg Univ. (Netherlands). Dept. of Econometrics.
ON THE STRATEGIC FORMATION OF COMMUNICATION LINKS Abstract Only **c66**
Peter Borm *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 127 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Given a cooperative game in coalition form, which communication links between the players will be activated? To analyze this question, two types of noncooperative games are considered: the extensive form model of Aumann and Myerson and the normal form model of Borm, van den Nouweland, and Tijs. In both cases, the payoff functions are obtained from the Myerson value (or alternatively, the positive value) for communication games, and refinements of Nash equilibria are used to determine stable communication structures. The two approaches are illustrated and compared in particular examples. ESA

N92-24931# Bonn Univ. (Germany, F.R.). Dept. of Computer Science.
EFFICIENT PARALLEL RECOGNITION ALGORITHMS OF COGRAPHS AND DISTANCE HEREDITARY GRAPHS Abstract Only **c61**
Elias Dahlhaus *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 127 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A parallel algorithm for the recognition of cographs with a linear processor bound and a log squared n time bound is presented. This result extends the result of Adhar and Peng. The processor number is better than that of the algorithm of Lin and Olariu (O(nm) processors and O(log n) time). As a consequence, distance hereditary graphs can be recognized by the same processor and time bound. ESA

N92-24932# Technische Hochschule, Aachen (Germany, F.R.). Lehrstuhl fuer Mathematik.
AVERAGE DISTANCE AND INDEPENDENCE NUMBER Abstract Only
Peter Dankelmann *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 128 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

The computer program GRAFFITY gave a lower bound on the independence number for the average distance of a finite, simple, and undirected graph, which is computable in polynomial time. An upper bound is given. All extremal graphs are determined. As a corollary to the theorem, the maximal average distance of graph whose order and matching number are given, is obtained. ESA

N92-24933# Rostock Univ. (German D.R.). Fachbereich Mathematik.
PERFECTLY ORDERABLE GRAPHS AND ALMOST ALL PERFECT GRAPHS ARE KERNEL M-SOLVABLE Abstract Only
Konrad Engel and Mostafa Blidia *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 129 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A graph is perfectly orderable if and only if it admits an acyclic orientation which does not contain an induced subgraph with vertices a, b, c , d and arcs ab, bc, dc. Further, a graph is called kernel M solvable if for every direction of the edges (here pairs of symmetric, i.e., reversible, arcs are allowed) such that every directed triangle possesses at least two pairs of symmetric arcs, there exists a kernel, i.e., an independent set K of vertices such that every other vertex sends some arc towards K. Perfectly orderable graphs are proven to be kernel M solvable. Using a deep result of Proemel and Steger, almost all perfect graphs are derived to be kernel M solvable. This supports the Meyniel conjecture that all perfect graphs are kernel M solvable. The problem of whether almost all perfect graphs are solvable is discussed: a graph is perfect if it is solvable. Here a graph is solvable if for every direction D of the edges, such that every (directed) clique has a kernel, there exists in D a kernel. ESA

N92-24934# Universiteit Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
ON THE MULTIWAY CUT PROBLEM Abstract Only
Peter L. Erdoes and Laszlo A. Szekely (Eoetvoes Lorand Univ., Budapest, Hungary) *In its* Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 129 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Let G be a graph with V(G) vertices and E(G) edges, and E(G) onto N(+) (the set of Natural numbers), a weight function. Let N be a subset of the vertices of G. A subset F of edges is a multiway cut, if it separates all pairs of vertices of N. To find a multiway cut of minimal total weight is known as the Multiway Cut Problem (MCP). An instance of MCP for which a Menger type theorem holds is presented. The proof is algorithmic. The LP dual of the instance is a multicommodity flow problem for which a maximum-flow minimum-cut theorem holds. A graph theoretial conjecture that would imply NP = co-NP is posed. ESA

N92-24935# Universiteit Twente, Enschede (Netherlands).
ON THE GAME CHROMATIC NUMBER OF SOME CLASSES OF GRAPHS Abstract Only **c66**
U. Faigle, W. Kern, H. Kierstead, and W. T. Trotter (Arizona State Univ., Tempe.) *In its* Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 130 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

The following two person game on the graph G is considered. Players 1 and 2 move alternatingly. Each move consists in coloring a yet uncolored vertex of G properly using a prespecified set of colors. The game ends when some player can no longer move. Player 1 wins if all of G is colored. Otherwise player 2 wins. What is the minimal number gamma(G) of colors such that player 1 has a winning strategy? Improving a result of Bodlaender, gamma(T) is shown to be less than or equal to 4 for each tree T. Also, gamma(G) is proved to equal O(log(G)) for graphs G that are unions of k trees, and this in particular for the class of planar

graphs. Gamma(G) is bounded by 3(omega)(G) - 2 for interval graphs G. The order of magnitude of gamma(G) can generally not be improved for k fold trees. The problem remains open for planar graphs. ESA

N92-24936# Technische Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
ON TOLERANCE GRAPHS Abstract Only
Stefan Felsner *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 131 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Conditions for an undirected graph to be a 'tolerance graph' are described. Previous results on tolerance graphs are outlined and referenced. The results include the following: (1) tolerance graphs are perfectly orderable; and (2) they do not contain holes or antiholes of size greater than or equal to 5. They also posed some open problems on the characterization of tolerance and bounded tolerance graphs. A tolerance graph G is called a proper tolerance graph if G admits a tolerance representation in which no interval properly contains another interval. If every interval is of unit length, then G is called a unit tolerance graph. It is easy to see that unit tolerance graphs are proper and proper tolerance graphs are bounded. ESA

N92-24937# Technische Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
ON THE CHROMATIC NUMBER OF DIAGRAMS Abstract Only
Jens Gustedt, Stefan Felsner, Michel Morvan, and Jean-Xavier Rampon (Universite des Sciences et Techniques du Languedoc, Montpellier, France) *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 132 Sponsored by PROCOPE Program and DFG (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Conditions concerning a partially ordered set (poset (P)) and an orientation for an undirected graph diagram are given. An explicit construction of an order P with given chi(D(P)) is given. This order is the interval order, as N free. This leads to special classes of orders. Bounds for chi(D(P)) are also given for arbitrary poset P. ESA

N92-24938# Technische Univ., Brunswick (Germany, F.R.). Diskrete Math.
MAXIMUM NUMBERS OF CROSSINGS Abstract Only
Heiko Harborth *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 133 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

In drawings of graphs in-the-plane, two edges have at most one point in common, either an endpoint or a crossing. The maximum numbers of crossings for some classes of graphs are discussed. ESA

N92-24939# Universite des Sciences et Techniques du Languedoc, Montpellier (France). Centre de Recherche en Informatique.
COMPUTING THE JUMP NUMBER ON SEMI-ORDERS IS POLYNOMIAL Abstract Only
C. delaHiguera (Centre National de la Recherche Scientifique, Montpellier, France) *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 133 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Semi-orders form a subclass of interval orders; they can be represented as sets of intervals of a given length. It is proved that semi-orders can be partitioned by serialization (or series decomposition) without loss of the jump number aspect. On non-serializable semi-orders, all linear extensions contain no more than two consecutive bumps (maximal chains of length almost 3). A 'divide and conquer' argument proving that to solve this case all that is needed is to solve the case where the length of maximal chains is limited by 2 is given. This can also be dealt with in polynomial time by a maximum matching technique, allowing the claim that computing the jump number is polynomial of semi-orders. ESA

N92-24940# Technische Univ., Brunswick (Germany, F.R.).
INTEGRAL DRAWINGS OF PLANAR GRAPHS Abstract Only
Arnfried Kemnitz *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 133 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

An integral drawing of a graph G is such a realization of G in the plane that the vertices of G are mapped into distinct points, also called vertices, and the edges of G are mapped into straight line segments of integer length, also called edges, which connect the corresponding vertices such that two edges have at most one point in common, either a vertex or a point of intersection. For any graph G there exists an integral drawing. An old result of Wagner and Fary states that every planar graph G has a plane straight line drawing, that means, a drawing in the plane with no crossings such that all the edges are straight line segments. It is conjectured that, moreover, a plane integral drawing exists for every planar graph G. Some steps of a possible proof of this conjecture are discussed. ESA

N92-24941# Technische Hochschule, Darmstadt (Germany, F.R.).
THE JUMP NUMBER OF INTERVAL ORDERS IS NP-COMPLETE Abstract Only
Jutta Mitas *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 134 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Although the jump number problem for partially ordered sets (posets) is NP complete in general, there are some special classes of posets for which polynomial time algorithms are known. For the class of interval orders the problem is proved to remain NP complete. A 3/2 approximation algorithm is described by considering a given subgraph packing problem. ESA

N92-24942# Technische Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
BOUNDING THE DISTRIBUTION OF PROJECT DURATION OF STOCHASTIC PROJECT NETWORKS Abstract Only **c65**
Rudolf Mueller and Rolf H. Moehring *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 135 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Results for evaluating a project network (an acyclic directed graph) N whose activities (the edges of N) have independent random processing times are presented with the aim of obtaining information about the random shortest project duration (PD). It is known that calculating the distribution function of PD is hash-P complete. This motivates the study of obtaining stochastic upper and lower bounds for the distribution of PD. Several known bounds are generalized by a minor construction for partially ordered sets and their path clutters. The evaluation problem at one point is shown to remain weakly NP hard even for series parallel networks with discrete processing time distributions, while it becomes polynomial in the number of values of the project duration. ESA

N92-24943# Erasmus Univ., Rotterdam (Netherlands). Econometrisch Inst.
THE EXPANSION PROCEDURE FOR GRAPHS Abstract Only
Henry Martyn Mulder *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 135 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A construction is proposed to obtain graphs from smaller graphs by expansion. A graph with m subgraphs all having the same part in common and without connections outside the common part is covered. These covering subgraphs are pulled apart and new edges are inserted between the respective copies of the common part. By specifying conditions in the cover and by specifying how to

insert new edges, particular instances of expansion are obtained. These yield specific classes of expansion graphs, which can be studied inductively. Thus a 'masterplan' is proposed to study various expansion classes. How fruitful this approach can be is shown in the case of median graphs. ESA

N92-24944# Freie Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
A FAST O(n) EMBEDDING ALGORITHM BASED ON THE HOPCROFT-TARJAN PLANARITY TEST Abstract Only
Petra Mutzel *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 136 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Embedding a planar graph G means to construct adjacency lists A of G such that, in each A(v), all the neighbors of v appear in clockwise order with respect to an actual planar drawing. Such a set A of adjacency lists is called a (topological) embedding of G. A linear algorithm based on the 'vertex-addition' planarity testing algorithm, that makes use of a PQ tree, is presented. It is very complicated to implement this data structure. It is also claimed that it is fairly complicated to modify the other planarity testing algorithm, the 'path addition' algorithm of Hopcroft and Tarjan, such that it actually gives an embedding. A linear embedding algorithm based on the Hopcroft-Tarjan planarity tests is presented. ESA

N92-24945# Technische Hochschule, Aachen (Germany, F.R.). Lehrstuhl fuer Mathematik.
HOW TO FIND OVERFULL SUBGRAPHS IN GRAPHS WITH LARGE MAXIMUM DEGREE Abstract Only
Thomas Niessen *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 137 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Algorithms for classification problems in graph theory are addressed. For certain types of graphs it seems that the existence of an overfull subgraph is equivalent to the class 2 property. A fast algorithm for finding all overall subgraphs in a given graph is presented. ESA

N92-24946# Tilburg Univ. (Netherlands). Dept. of Econometrics.
ON THE CONVEXITY OF COMMUNICATION GAMES Abstract Only
Anne vandenNouweland and Peter Borm *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 138 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A communication situation consists of a game and a communication graph. By introducing two different types of corresponding communication games, point games and arc games, the Myerson value and the position value of a communication situation were introduced. Relations between convexity of the underlying game and the two communication games are investigated. In particular, assuming the underlying game to be convex, necessary and sufficient conditions in the communication graph are provided such that the communication games are convex. Moreover, under the same conditions, it is shown that the Myerson value and the position value are in the core of the point game. Some remarks are made on superadditivity and balancedness. ESA

N92-24947# Bielefeld Univ. (Germany, F.R.).
GRAPHS ORIENTABLE AS IN-TOURNAMENTS Abstract Only
Erich Prisner *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 138 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

The question of which undirected graphs can be oriented in such a way that any two predecessors of any vertex are adjacent is addressed. These graphs can be recognized in time O(delta m), where delta denotes the maximum degree and m the number of edges. The following two results were proved: any intersection graph of subtrees of a unicyclic graph is orientable in this way; any graph orientable in this way must be 1-homotopic. It is well known that exactly the chordal graphs allow such an orientation which is moreover acyclic. If it is asked on the contrary which graphs have such a strongly connected orientation, then a more difficult problem is posed. Partial answers for this problem are given. ESA

N92-24948# Freiberg Mining Academy (German D.R.). Fachbereich Mathematik.
REMARKS ON HAMILTONIAN PROPERTIES OF POWERS OF DIGRAPHS Abstract Only
G. Schaar *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 139 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

A study on which way for special classes of finite digraphs the Hamiltonian behavior depends on raising a digraph to some power is presented. For every directed cactus G (i.e., G is a strongly connected digraph each edge of which belongs to exactly one cycle in G) its cube can be proved to be Hamiltonian and even Hamiltonian connected. For every k greater than or equal to 1 there are strongly connected digraphs G such that G to the power k is not Hamiltonian. ESA

N92-24949# Technische Hochschule, Aachen (Germany, F.R.). Lehrstuhl fuer Mathematik.
A CLOSURE CONCEPT FOR THE k-SATISFIABILITY PROBLEM Abstract Only
Ingo Schiermeyer *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 139 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Given a family F of n clauses of size k over r boolean variables in conjunctive normal form, the possibilities that a clause C can be added to F with respect to a subset S of F containing p clauses for some (p greater than or equal to 2 and less than or equal to n) such that F is satisfiable if F + C is satisfiable, are considered. For (p greater than or equal to 2 and less than or equal to n) the p closure of F is defined, denoted as C(sub p)F, as the unique family of clauses which can be obtained from F by successively adding a clause C of K(sub r) - F' with respect to a suitable subset S of F' containing p clauses, where F subset F' proper subset C(sub p)F and K(sub r) is the complete family (of all possible clauses of size k over r variables). Then F is satisfiable if C(sub p)F is satisfiable. Furthermore, C(sub p)F can be determined in polynomial time for each fixed p greater than or equal to 2 and if C(sub p)F is the complete family then F is unsatisfiable. ESA

N92-24950# Tilburg Univ. (Netherlands).
LP-GAMES AND COMBINATORIAL OPTIMIZATION GAMES Abstract Only
Stef Tijs *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 140 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Many cost and reward allocation situations give rise to coalition games where the worth of each coalition is determined by solving a (combinatorial) optimization problem. Examples of such classes of games are discussed such as traveling salesman games, sequencing games, flow games, linear production games and minimum spanning tree games. Special properties, such as balancedness and convexity are investigated for such games. Some special allocation rules are considered. ESA

N92-24951# Hungarian Academy of Sciences, Budapest. Inst. of Computer and Automation.
PACKING, COVERING, DECOMPOSITION Abstract Only
Zsolt Tuza *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 140 (For

primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Some old and new problems, conjectures, and theorems concerning the largest size of matchings, smallest cardinality of covering sets, and minimum number of substructure in a decomposition with a given property, in graphs and hypergraphs, are discussed. ESA

N92-24952# Netherlands School of Business, Breukelen. Dept. of Quantitative Methods.
THE SYMMETRIC CIRCULANT TRAVELING SALESMAN PROBLEM Abstract Only
Jack A. A. vanderVeen, Rene vanDal, and Gerard Sierksma (Groningen Rijksuniv., Netherlands) *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 141 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

The Symmetric Circulant Traveling Salesman Problem (SCTSP) is the problem of finding a shortest tour through a number of cities where the distance matrix is symmetric and circulant. It is an open problem whether the SCTSP is NP hard or polynomially solvable. However, related problems, namely the Hamiltonian path problem and the bottleneck TSP restricted to symmetric cirulant matrices are known to be efficiently solvable. Two heuristics for the SCTSP are presented. Each is inspired by one of the algorithms for the two well solvable related problems. One of the heuristics is shown to have a worst case ratio of two. A lowerbound for the SCTSP is given and for quite a broad class of distance matrices at least one of the two heuristics is shown to solve the SCTSP to optimality. By computational experiments on randomly generated symmetric circulant distance matrices it is shown that the two heuristics are superior to some well known heuristic for the general symmetric TSP and that the average relative difference in length between a tour produced by the heuristics presented here and an optimal tour is very small. ESA

N92-24953# Technische Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
AVOIDING BENDS IN KNOCK-KNEE CHANNEL ROUTING Abstract Only
Dorothea Wagner *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 142 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

Channel routing is a basic problem in the design of VLSI (Very Large Scale Integration) circuits. An instance consists of a rectangular grid graph, the channel and distinct grid points (terminals) on the upper and lower boundary of the grid. The set of terminals is partitioned into pairs, called nets with one terminal in each boundary. These have to be connected. A solution (layout) is given by edge-disjoint paths (wires) that connect corresponding terminals within the channel. The knock-knee routing model, where two wires may cross or both bend at a vertex, i.e., form a knock-knee, is considered. To avoid physical contacts between different wires, the edges for the paths are assigned to different layers, such that no two wires share a grid vertex in the same layer (wiring). Connections between distinct layers (called vias) are placed on grid points. The most important optimization criteria for the design of layout algorithms are the layout area, the number of layers and vias used for the wiring, the length of the wires, the number of bends and the time complexity of the algorithms. The number of bends contained in a layout for a dense problem is considered. An approach based on the cycle structure of the problem is addressed. This leads to an algorithm that constructs a layout of minimum area with minimum total wire length and O(n) bends, where the number of additional bends in the layout is at most d (with d density of the problem, which is equal to the number of tracks). The time complexity is O(n), which is an essential improvement of the results known before. ESA

N92-24954# Technische Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
MAX-FLOW UNDER SIDE-CONSTRAINTS IN FLOW DISTRIBUTION Abstract Only
Karsten Weihe *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 143 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

The so called 'time cost tradeoff problem' can be solved by an iterative algorithm where the central point in each iteration step is finding a maximum flow in the corresponding project network. Considering a 'sum of weighted completion times' instead of the 'total project duration' leads to a similar algorithm where a given problem with side constraints has to be solved. An algorithm is introduced that solves this problem. Some extensions make this algorithm applicable to more general side constraints on flow distribution. ESA

N92-24955# Academy of Mining and Metallurgy, Cracow (Poland). Inst. Matematyki.
CYCLES THROUGH MATCHINGS Abstract Only
A. Pawel Wojda *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 143 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

In 1983 Berman proved the following result conjectured in 1979 by Haggkvist: let G be a graph of order n greater than or equal to 3 in which d(x) + d(y) greater than or equal to n + 1 for pairs of independent vertices x and y; then every matching M of G is contained in a cycle of G. Another sufficient condition for a graph to contain every matching in a cycle and in a Hamiltonian cycle is given. ESA

N92-24963# Helsinki Univ. of Technology, Espoo (Finland). Lab. for Strength of Materials.
STABILIZED FINITE ELEMENT METHODS FOR THE STOKES PROBLEM
Leopoldo P. Franca, Thomas J. R. Hughes (Stanford Univ., CA.), and Rolf Stenberg Jan. 1991 26 p Submitted for publication
(PB92-142298; ISBN-951-22-0525-4; Rept-11; ISSN-0783-9375)
Avail: NTIS HC/MF A03 CSCL 12A

Physically the Stokes equations model 'slow' flows of incompressible fluids or alternatively isotropic incompressible elastic materials. In Computational Fluid Dynamics, however, the Stokes equations are an important model problem for designing and analyzing finite element algorithms. The reason being, that some of the problems encountered when solving the full Navier-Stokes equations are already present in the more simple Stokes equations. In particular, it gives the right setting for studying the stability problem connected with the choice of finite element spaces for the velocity and the pressure. It is well known that these spaces cannot be chosen independently when the discretization is based on the Galerkin variational form. In the chapter the authors review a recent technique of stabilizing mixed methods. In the approach the standard Galerkin form is modified by the addition of mesh-dependent terms which are weighted residuals of the differential equations. By the technique it is possible to avoid the stability problem connected with the classical mixed methods and hence the convergence can be established for a wide family of simple interpolations. GRA

N92-24973*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
ON THE GIBBS PHENOMENON 1: RECOVERING EXPONENTIAL ACCURACY FROM THE FOURIER PARTIAL SUM OF A NON-PERIODIC ANALYTIC FUNCTION Final Report
David Gottlieb, Chi-Wang Shu, Alex Solomonoff, and Herve Vandeven Feb. 1992 27 p Submitted for publication
(Contract NAS1-18605)
(NASA-CR-189609; NAS 1.26:189609; ICASE-92-4) Avail: NTIS HC/MF A03 CSCL 12A

It is well known that the Fourier series of an analytic or periodic function, truncated after 2N+1 terms, converges exponentially with

N, even in the maximum norm, although the function is still analytic. This is known as the Gibbs phenomenon. Here, we show that the first 2N+1 Fourier coefficients contain enough information about the function, so that an exponentially convergent approximation (in the maximum norm) can be constructed. Author

N92-24974*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ASYMPTOTIC INTEGRATION ALGORITHMS FOR FIRST-ORDER ODEs WITH APPLICATION TO VISCOPLASTICITY
Alan D. Freed, Minwu Yao, and Kevin P. Walker (Engineering Science Software, Inc., Smithfield, RI.) Apr. 1992 18 p Proposed for presentation at the Conference Recent Advances in Damage Mechanics and Plasticity, Tempe, AZ, 28 Apr. - 1 May 1992; sponsored by the 1992 ASME Summer Mechanics and Materials Conference
(NASA-TM-105587; E-6916; NAS 1.15:105587) Avail: NTIS HC/MF A03 CSCL 12A

When constructing an algorithm for the numerical integration of a differential equation, one must first convert the known ordinary differential equation (ODE), which is defined at a point, into an ordinary difference equation (O(delta)E), which is defined over an interval. Asymptotic, generalized, midpoint, and trapezoidal, O(delta)E algorithms are derived for a nonlinear first order ODE written in the form of a linear ODE. The asymptotic forward (typically underdamped) and backward (typically overdamped) integrators bound these midpoint and trapezoidal integrators, which tend to cancel out unwanted numerical damping by averaging, in some sense, the forward and backward integrations. Viscoplasticity presents itself as a system of nonlinear, coupled first-ordered ODE's that are mathematically stiff, and therefore, difficult to numerically integrate. They are an excellent application for the asymptotic integrators. Considering a general viscoplastic structure, it is demonstrated that one can either integrate the viscoplastic stresses or their associated eigenstrains. Author

N92-24979* University of Southern California, Los Angeles. Center for Applied Mathematical Sciences.
COMPUTATIONAL ISSUES IN PARAMETER ESTIMATION AND FEEDBACK CONTROL PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATION SYSTEMS Abstract Only
H. T. Banks Jun. 1991 2 p Presented at the Conference on Experimental Mathematics: Computational Issues in Nonlinear Sciences, Los Alamos, NM, 20-24 May 1991
(Grants NAG1-1116; AF-AFOSR-0091-90; NSF DMS-88-18530)
(NASA-CR-190324; NAS 1.26:190324) Avail: Issuing Activity CSCL 12A

Computational aspects are considered of two problems governed by partial differential equations systems: (1) the computation of approximate Riccati feedback gains for Linear Quadratic Regulator control problems; and (2) the estimation of parameters using methods based on approximate gradients computed via a costate algorithm. Sufficient conditions for convergence of algorithms for these problems are discussed; in both cases, some type of adjoint or costate system convergence is required in addition to the expected system convergence. Examples are discussed that show computational difficulties which may arise if only convergence of the approximate system holds (i.e., in the event costate convergence does not hold). Author

N92-24980*# Chicago Univ., IL.
THE SYMBOLIC COMPUTATION OF SERIES SOLUTIONS TO ORDINARY DIFFERENTIAL EQUATIONS USING TREES (EXTENDED ABSTRACT)
Robert Grossman Nov. 1991 14 p
(Grant NAG2-513)
(NASA-CR-190333; NAS 1.26:190333) Avail: NTIS HC/MF A03 CSCL 12A

Algorithms previously developed by the author give formulas which can be used for the efficient symbolic computation of series expansions to solutions of nonlinear systems of ordinary differential equations. As a by product of this analysis, formulas are derived which relate to trees to the coefficients of the series expansions, similar to the work of Leroux and Viennot, and Lamnabhi, Leroux and Viennot. Author

N92-24983*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
FAST WAVELET BASED ALGORITHMS FOR LINEAR EVOLUTION EQUATIONS Final Report
Bjorn Engquist, Stanley Osher, and Sifen Zhong Apr. 1992 29 p Submitted for publication
(Contracts NAS1-18605; N00014-91-J-1034)
(NASA-CR-189636; ICASE-92-14; NAS 1.26:189636) Avail: NTIS HC/MF A03 CSCL 12A

A class was devised of fast wavelet based algorithms for linear evolution equations whose coefficients are time independent. The method draws on the work of Beylkin, Coifman, and Rokhlin which they applied to general Calderon-Zygmund type integral operators. A modification of their idea is applied to linear hyperbolic and parabolic equations, with spatially varying coefficients. A significant speedup over standard methods is obtained when applied to hyperbolic equations in one space dimension and parabolic equations in multidimensions. Author

N92-25033# International Centre for Theoretical Physics, Trieste (Italy).
ON BIRECURRENT SPACES
M. S. Rahman Oct. 1991 8 p
(DE92-619284; IC-91/331) Avail: NTIS HC/MF A02

A birecurrent space is defined with its classification and studied with involvement of Einstein, conformally flat, conformally symmetric and conformally recurrent spaces. A necessary and sufficient condition that a birecurrent space be recurrent is found. DOE

N92-25037# Lawrence Livermore National Lab., CA.
VOLUME VISUALIZATION FOR ADAPTIVE MESH REFINEMENT
N. L. Max Apr. 1991 5 p Presented at the Visual 1991, San Diego, CA, 22-25 Oct. 1991
(Contract W-7405-eng-48)
(DE92-009115; UCRL-JC-107038; CONF-9110123-3) Avail: NTIS HC/MF A01

The adaptive mesh refinement method for solving partial differential equations subdivides the grid in regions of high variation, where finer grids are necessary to produce accurate solutions, while keeping coarser grids where they are adequate. Visualization techniques which take advantage of volume coherence can efficiently render the larger grid cells, and concentrate computation time on the finely subdivided regions containing the details of interest. DOE

N92-25102# Helsinki Univ. of Technology, Espoo (Finland). Inst. of Mathematics.
CHARACTERIZATION OF POWER BOUNDED OPERATORS
O. Nevanlinna Oct. 1990 8 p
(PB92-141498; RR-A284; ISBN-951-22-0427-4) Avail: NTIS HC/MF A02 CSCL 12A

A discrete analog of the Hille-Yosida theorem was formulated in a lecture series on iterations. The theorem is presented here as a separate note in the hope that it would lead to the uncovering of the earlier discoveries of the same, simple result. Author

N92-25103# Helsinki Univ. of Technology, Espoo (Finland). Inst. of Mathematics.
SOME REMARKS ON POLYNOMIAL ACCELERATION OF LINEAR ITERATIVE PROCESSES
O. P. Piirilae May 1991 14 p
(PB92-141522; RR-A294; ISBN-951-22-0669-2) Avail: NTIS HC/MF A03 CSCL 12A

The theoretical limits of polynomial acceleration of certain linear iterative processes are studied. In particular, the author investigates through an example the case where the spectrum of the linear operator involved has zero capacity. Author

N92-25127# International Centre for Theoretical Physics, Trieste (Italy).
ITERATIVE SOLUTION OF NONLINEAR EQUATIONS WITH STRONGLY ACCRETIVE OPERATORS
C. E. Chidume Oct. 1991 11 p
(DE92-619244; IC-91/361) Avail: NTIS HC/MF A03

Let E be a real Banach space with a uniformly convex dual, and let K be a nonempty closed convex and bounded subset of E. Suppose T:K yields K is a strongly accretive map such that for each f is an element of K the equation Tx = f has a solution in K. It is proved that each of the two well known fixed point iteration methods (the Mann and Ishikawa iteration methods) converges strongly to a solution of the equation Tx = f. Furthermore, our method shows that such a solution is necessarily unique. Explicit error estimates are given. Our results resolve in the affirmative two open problems (J. Math. Anal. Appl. Vol 151(2) (1990), p. 460) and generalize important known results. DOE

N92-25128# International Centre for Theoretical Physics, Trieste (Italy).
APPROXIMATION OF FIXED POINTS OF STRONGLY PSEUDO-CONTRACTIVE MAPPINGS
C. E. Chidume Oct. 1991 10 p
(DE92-619245; IC-91/362) Avail: NTIS HC/MF A02

Let E be a real Banach space with a uniformly convex dual, and let K be a nonempty closed convex and bounded subset of E. Let T:K yields K be a continuous strongly pseudocontractive mapping of K into itself. Let (c sub n) sub n = 1 sup (infinity) be a real sequence satisfying: (1) 0 less than c sub n less than 1 for all n(greater than =) 1; (2) Sigma sub n = 1 sup infinity) c sub n = infinity; and (3) Sigma sub n = 1 sup infinity c sub n b c(sub n) less than infinity, where b:(0,infinity) yields (0,infinity) is some continuous nondecreasing function satisfying b(0) = 0, b(ct) less than or = cb(t) for all c greater than or = 1. Then the sequence (x sub n) sub n = 1 sup infinity generated by x sub 1 is an element of K. x sub n+1 = (1-c sub n) x sub n + c sub n Tx sub n, n greater than or = 1, converges strongly to the unique fixed point of T. A related result deals with the Ishikawa iteration scheme when T is Lipschitzian and strongly pseudocontractive. DOE

N92-24309*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NONLINEAR, NONBINARY CYCLIC GROUP CODES
G. Solomon *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 84-95 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 12A

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N92-24971# Lawrence Livermore National Lab., CA.
ALTERNATE METHODS FOR FAAT S-CURVE GENERATION
A. M. Kaufman 2 Dec. 1991 7 p
(Contract W-7405-eng-48)
(DE92-007277; UCRL-ID-108850) Avail: NTIS HC/MF A02

The FAAT (Foreign Asset Assessment Team) methodology attempts to derive a probability of effect as a function of incident field strength. The probability of effect is the likelihood that the stress put on a system exceeds its strength. In the FAAT methodology, both the stress and strength are random variables whose statistical properties are estimated by experts. Each random variable has two components of uncertainty: systematic and random. The systematic uncertainty drives the confidence bounds in the FAAT assessment. Its variance can be reduced by improved information. The variance of the random uncertainty is not reducible. The FAAT methodology uses an assessment code called ARES to generate probability of effect curves (S-curves) at various confidence levels. ARES assumes log normal distributions for all random variables. The S-curves themselves are log normal cumulants associated with the random portion of the uncertainty. The placement of the S-curves depends on confidence bounds. The systematic uncertainty in both stress and strength is usually described by a mode and an upper and lower variance. Such a description is not consistent with the log normal assumption of ARES and an unsatisfactory work around solution is used to obtain the required placement of the S-curves at each confidence level. We have looked into this situation and have found that significant errors are introduced by this work around. These errors are at least several dB-W/sq cm at all confidence levels, but they are especially bad in the estimate of the median. In this paper, we suggest two alternate solutions for the placement of S-curves. To compare these calculational methods, we have tabulated the common combinations of upper and lower variances and generated the relevant S-curve offsets from the mode difference of stress and strength. DOE

N92-24942# Technische Univ., Berlin (Germany, F.R.). Fachbereich Mathematik.
BOUNDING THE DISTRIBUTION OF PROJECT DURATION OF STOCHASTIC PROJECT NETWORKS Abstract Only
Rudolf Mueller and Rolf H. Moehring *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 135 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N92-24783# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
MISSION OPERATIONS OF THE SPACECRAFT HITEN
K. Uesugi, J. Kawaguchi, N. Ishii, M. Shuto, M. Kamimura, N. Muranaka, M. Uo, M. Ogasawara, A. Kimura, and S. Ishii (Nippon Electric Co. Ltd., Japan) et al *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 465-470 (For primary document see N92-24719 15-12)
Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24784# Grupo de Mecanica del Vuelo S.A., Madrid (Spain).
ON THE 3-D CONFIGURATION OF THE CLUSTER MISSION
M. Bello-Mora and J. Rodriguez-Canabal (European Space Agency. European Space Operations Center, Darmstadt, Germany, F.R.) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 471-479 (For primary document see N92-24719 15-12)
Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24786# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
THE GIOTTO ENCOUNTER WITH COMET P/GRIGG-SKJELLERUP
T. A. Morley *In its* Spacecraft Flight Dynamics Dec. 1991 p 487-491 (For primary document see N92-24719 15-12)
Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24930# Tilburg Univ. (Netherlands). Dept. of Econometrics.
ON THE STRATEGIC FORMATION OF COMMUNICATION LINKS Abstract Only
Peter Borm *In* Univ. Twente, Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 127 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

N92-24935# Universiteit Twente, Enschede (Netherlands).
ON THE GAME CHROMATIC NUMBER OF SOME CLASSES OF GRAPHS Abstract Only
U. Faigle, W. Kern, H. Kierstead, and W. T. Trotter (Arizona State Univ., Tempe.) *In its* Second Twente Workshop on Graphs and Combinatorial Optimization May 1991 p 130 (For primary document see N92-24905 15-64)
Avail: NTIS HC/MF A08

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N92-24258# International Centre for Theoretical Physics, Trieste (Italy).
EXACTLY SOLUBLE MATRIX MODELS
R. RajuViswanathan Sep. 1991 9 p
(DE92-615219; IC-91/278) Avail: NTIS HC/MF A02

We study examples of one dimensional matrix models whose potentials possess an energy spectrum that can be explicitly determined. This allows for an exact solution in the continuum limit. Specifically, step-like potentials and the Morse potential are considered. The step-like potentials show no scaling behavior and the Morse potential (which corresponds to a gamma = -1 model) has the interesting feature that there are no quantum corrections to the scaling behavior in the continuum limit. DOE

N92-24261# International Centre for Theoretical Physics, Trieste (Italy).
ON THE EXISTENCE OF n-DIMENSIONAL INDECOMPOSABLE VECTOR BUNDLES
Xiao-Jiang Tan Sep. 1991 22 p
(DE92-615230; IC-91/225) Avail: NTIS HC/MF A03

Let X be an arbitrary smooth irreducible complex projective curve of genus g with g greater than or = 4. In this paper we extend the existence theorem of special divisors to high dimensional indecomposable vector bundles. We give a necessary and sufficient condition on the existence of n-dimensional indecomposable vector bundles E with deg(E) = d, dimH(sup 0)(X,E) greater than or = h. We also determine under what condition the set of all such vector bundles will be finite and how many elements it contains. DOE

N92-24266# International Centre for Theoretical Physics, Trieste (Italy).
LIOUVILLE THEOREM FOR EXPONENTIALLY HARMONIC FUNCTION ON RIEMANNIAN MANIFOLDS
Min-Chun Hong Sep. 1991 8 p
(DE92-615235; IC-91/270) Avail: NTIS HC/MF A02

Suppose that M is a complete Riemannian manifold with nonnegative sectional curvature. We prove that any bounded exponentially harmonic function on M is a constant function. DOE

N92-24300# International Centre for Theoretical Physics, Trieste (Italy).
ON THE COGOSVILI FUNCTOR GENERATED BY A HOMOLOGY
A. Dabbour AbdEl-Satter and S. Mahmoud (Ain Shams Univ., Cairo, Egypt) Sep. 1991 13 p
(DE92-619283; IC-91/271) Avail: NTIS HC/MF A03

In the present work we discuss the Cogosvili functor generated by a homology, and study the construction of the corresponding groups and their induced homomorphisms. Moreover, we investigate the properties of this functor and prove that the set of such functors are isomorphic to the Bauer homotopy theory. DOE

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N92-25124# International Centre for Theoretical Physics, Trieste (Italy).
GENERALIZED TWO-BODY AND THREE-BODY SYSTEMS WITH NONHAMILTONIAN INTERNAL FORCES
R. M. Santilli Sep. 1991 12 p
(DE92-619235; IC-91/260) Avail: NTIS HC/MF A03

In this note, we review and expand the current knowledge on 'two body' and 'three body' systems with action-at-a-distance, potential (selfadjoint) forces, as well as contact, nonlinear and nonhamiltonian (nonselfadjoint) internal forces. The stable configuration of the two-body system is reviewed, and the two new stable configurations for the 'three body' system are introduced, one along a straight line (nonselfadjoint extension of the restricted 'three body' problem) and one along a triangle (nonselfadjoint extension of Lagrange's historical triangle) in preparation for their operator treatment. DOE

N92-25129# European Organization for Nuclear Research, Geneva (Switzerland).
THE 1989 CERN-JINR SCHOOL OF PHYSICS
28 Aug. 1991 217 p Meeting held in Egmond aan Zee, Netherlands, 25 Jun. - 8 Jul. 1989
(DE92-619246; CERN-91-07; CONF-8906420) Avail: NTIS HC/MF A10

The CERN School of Physics is intended to give young experimental physicists an introduction to the theoretical aspects of recent advances in elementary particle physics. These Proceedings contain reports of lecture series on the following topics: Gauge theories and applications, precision tests of the electroweak theory (in two parts), physics beyond the Standard Model, and the experimental program at the IHEP accelerator. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N92-24251*# Continuum Dynamics, Inc., Princeton, NJ.
ANALYSIS OF ROTOR VIBRATORY LOADS USING HIGHER HARMONIC PITCH CONTROL Final Report
Todd R. Quackenbush, Donald B. Bliss, Alexander H. Boschitsch, and Daniel A. Wachspress Apr. 1992 61 p
(Contract NAS1-19160)
(NASA-CR-189591; NAS 1.26:189591; CDI-91-03) Avail: NTIS HC/MF A04 CSCL 20A

Experimental studies of isolated rotors in forward flight have indicated that higher harmonic pitch control can reduce rotor noise. These tests also show that such pitch inputs can generate substantial vibratory loads. The modification is summarized of the RotorCRAFT (Computation of Rotor Aerodynamics in Forward flighT) analysis of isolated rotors to study the vibratory loading generated by high frequency pitch inputs. The original RotorCRAFT code was developed for use in the computation of such loading, and uses a highly refined rotor wake model to facilitate this task. The extended version of RotorCRAFT incorporates a variety of new features including: arbitrary periodic root pitch control; computation of blade stresses and hub loads; improved modeling of near wake unsteady effects; and preliminary implementation of a coupled prediction of rotor airloads and noise. Correlation studies are carried out with existing blade stress and vibratory hub load data to assess the performance of the extended code. Author

N92-24688*# Sverdrup Technology, Inc., Brook Park, OH.
A SOPHISTICATED, MULTI-CHANNEL DATA ACQUISITION AND PROCESSING SYSTEM FOR HIGH FREQUENCY NOISE RESEARCH Final Report
David G. Hall and James Bridges Mar. 1992 8 p Proposed for presentation at the 1992 International Congress on Noise Control Engineering, Toronto, Ontario, 20-22 Jul. 1992; sponsored by the International Inst. of Noise Control Engineering
(Contract NAS3-25266)
(NASA-CR-189137; E-6936; NAS 1.26:189137) Avail: NTIS HC/MF A02 CSCL 20A

A sophisticated, multi-channel computerized data acquisition and processing system was developed at the NASA LeRC for use in noise experiments. This technology, which is available for transfer to industry, provides a convenient, cost-effective alternative to analog tape recording for high frequency acoustic measurements. This system provides 32-channel acquisition of microphone signals with an analysis bandwidth up to 100 kHz per channel. Cost was minimized through the use of off-the-shelf components. Requirements to allow for future expansion were met by choosing equipment which adheres to established industry standards for hardware and software. Data processing capabilities include narrow band and 1/3 octave spectral analysis, compensation for microphone frequency response/directivity, and correction of acoustic data to standard day conditions. The system was used successfully in a major wind tunnel test program at NASA LeRC to acquire and analyze jet noise data in support of the High Speed Civil Transport (HSCT) program. Author

N92-24800*# Eagle Engineering, Inc., Hampton, VA.
A SUMMARY OF XB-70 SONIC BOOM SIGNATURE DATA Final Report
Domenic J. Maglieri, Victor E. Sothcott, and Thomas N. Keefer, Jr. Apr. 1992 60 p
(Contract NAS9-17900)
(NASA-CR-189630; NAS 1.26:189630) Avail: NTIS HC/MF A04 CSCL 20A

A compilation is provided of measured sonic boom signature data derived from 39 supersonic flights (43 passes) of the XB-70 airplane over the Mach number range of 1.11 to 2.92 and an altitude range of 30500 to 70300 ft. These tables represent a convenient hard copy version of available electronic files which include over 300 digitized sonic boom signatures with their corresponding spectra. Also included in the electronic files is information regarding ground track position, aircraft operating conditions, and surface and upper air weather observations for each of the 43 supersonic passes. In addition to the sonic boom signature data, a description is also provided of the XB-70 data base that was placed on electronic files along with a description of the method used to scan and digitize the analog/oscillograph sonic boom signature time histories. Such information is intended to enhance the value and utilization of the electronic files.
Author

N92-24335*# David Taylor Research Center, Bethesda, MD. Computational Mechanics Div.
ACOUSTIC INTENSITY CALCULATIONS FOR AXISYMMETRICALLY MODELED FLUID REGIONS
Stephen A. Hambric and Gordon C. Everstine *In* Computer Software Management and Information Center, Twentieth NASTRAN (R) Users' Colloquium Apr. 1992 p 166-183 (For primary document see N92-24324 15-39)
Avail: NTIS HC/MF A09 CSCL 20A

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N92-24237# California Univ., Berkeley. Lawrence Berkeley Lab.
SIMULATIONS OF SILICON VERTEX TRACKER FOR STAR EXPERIMENT AT RHIC (RD-22)
G. Odyniec, D. Cebra, W. Christie, C. Naudet, L. Schroeder, W. Wilson, D. Liko, and S. Margetis (Johann-Wolfgang-Goethe-Univ., Frankfurt am Main, Germany, F.R.) Jan. 1992 17 p Presented at the Symposium on Relativistic Heavy Ion Collider (RHIC) Detector R/D, Upton, NY, 10-11 Oct. 1991
(Contract DE-AC03-76SF-00098)
(DE92-008289; LBL-31773; CONF-9110232-5) Avail: NTIS HC/MF A03

The first computer simulations to optimize the silicon vertex tracker (SVT), which was designed for the STAR experiment, are presented. The proposed tracking system will consist of the SVT to locate the primary interaction and secondary decay vertices and to improve the momentum resolution, and a time projection chamber (TPC), positioned inside a solenoidal magnet, for continuous tracking, high momentum resolution, and particle identification. The extremely high position resolution required of the SVT detector is particularly important for the measurement of strangeness and charm production. DOE

N92-24238# California Univ., Berkeley. Lawrence Berkeley Lab.
A PROPOSED SEARCH FOR DARK-MATTER AXIONS IN THE 0.6-16 MU eV RANGE
C. Hagmann, D. M. Moltz, and M. S. Turner (Chicago Univ., IL.) Nov. 1991 5 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contracts DE-AC03-76SF-00098; DE-FG05-86ER-40272; DE-FG02-90ER-40560)
(DE92-008298; LBL-31570; CONF-911106-81) Avail: NTIS HC/MF A01

A proposed experiment is described to search for dark-matter axions in the mass range 0.6-16 micro-eV. The method is based on the Primakoff conversion of axions into monochromatic microwave photons inside a tunable microwave cavity in a large volume high field magnet. This proposal capitalized on the availability of two Axicell magnets from the MFTF-B fusion machine at LLNL. Assuming a local dark-matter density in axions of rho(sub a) = 0.3 GeV/cu cm, the axion would be found or ruled out at the 97 percent c.l. in the above mass range in 48 months. DOE

N92-24239# Sandia National Labs., Albuquerque, NM.
SINGLE EVENT UPSET AND CHARGE COLLECTION IMAGING USING ION MICROBEAMS
K. M. Horn, B. L. Doyle, F. W. Sexton, D. S. Walsh, G. J. F. Legge, M. Cholewa, A. Saint, and J. S. Laird 1991 8 p Presented at the International Workshop on Radiation Effects on Semiconductor Devices for Space Applications, Takasaki (Japan), 25-26 Feb. 1992
(Contract DE-AC04-76DP-00789)
(DE92-008320; SAND-92-0304C; CONF-920270-1) Avail: NTIS HC/MF A02

Single Event Upset Imaging utilizes the scanning of a micro-focused MeV ion beam across an integrated circuit to test the upset response of the circuit to energetic heavy ions. Using this technique, the position dependence of logic state upsets, as well as the charge collection efficiency of an integrated circuit, can be directly measured with micron resolution. We present in this paper a review of a series of measurements carried out on the TA670 16K static random access memory chip which displays this technique's capabilities. DOE

N92-24240# Los Alamos National Lab., NM.
SEARCH FOR THE H PARTICLE: ITS PRODUCTION AND WEAK DECAY
P. D. Barnes 1991 14 p Presented at the International

Symposium on Hypernuclear and Strange Particle Physics, Shimoda (Japan), 9-12 Dec. 1991
(Contract W-7405-eng-36)
(DE92-008439; LA-UR-92-535; CONF-911208-6) Avail: NTIS HC/MF A03

It is suggested that a six-quark state with the flavor content of two-lambda hyperons with all spins coupled to zero, the H particle, may be bound against strong decay. This particle is the object of extensive discussion in the literature and of several experimental searches. We report here the present status of an investigation of the reaction: (Xi(-),d)(sub atom) yields H + n. DOE

N92-24270# Oak Ridge National Lab., TN.
ADVANCED NEUTRON SOURCE (ANS) PROJECT Progress Report, FY 1991
J. H. Campbell, ed. Jan. 1992 99 p
(Contract DE-AC05-84OR-21400)
(DE92-008406; ORNL-6696) Avail: NTIS HC/MF A05

This report discusses the following about the Advanced Neutron Source: Project Management; Research and Development; Fuel Development; Corrosion Loop Tests and Analyses; Thermal-Hydraulic Loop Tests; Reactor Control and Shutdown Concepts; Critical and Subcritical Experiments; Material Data, Structural Tests, and Analysis; Cold-Source Development; Beam Tube, Guide, and Instrument Development; Hot-Source Development; Neutron Transport and Shielding; I & C Research and Development; Design; and Safety. DOE

N92-24276# International Centre for Theoretical Physics, Trieste (Italy).
PROPAGATION IN NON-LINEAR MEDIA: REFRACTIVE INDEX IN NON-LINEAR MEDIA
F. K. Faramawy, M. M. AbuSitta (Al-Azhar Univ., Cairo, Egypt), and A. S. F. Obada Aug. 1991 22 p
(DE92-615237; LAMP-91/7) Avail: NTIS HC/MF A03

A general theory of the effect of the electronic coupling between molecules on the response of the system as a whole to an external electromagnetic field is presented. The role of the nonlinear response function for various physical quantities and their Fourier transformation is discussed. The nonlinear susceptibilities to any rank for a denaturated system of particles are calculated. Also the nonlinear response function for a coupled system is computed. A nonlinear susceptibility for the electric dipole is obtained. Methods of the linear theory are developed to obtain the total nonlinear refractive index. DOE

N92-24279# Los Alamos National Lab., NM.
MARTIX ELEMENTS WITH WILSON FERMIONS
R. Gupta 1991 3 p Presented at the LATTICE 1991, Tsubuka (Japan), 5-9 Nov. 1991
(Contract W-7405-eng-36)
(DE92-008487; LA-UR-92-575; CONF-9111179-2) Avail: NTIS HC/MF A01

Highlights of the results for the spectrum, meson decay constants f(sub pi) and f(sub v)(sup -1), the chiral parameters m(sub q) and (anti psi)(psi), and the Kaon B Parameter are presented. The calculation was done using 35 quenched 16(sup 3) x 40 lattices at beta = 6.0 using Wuppertal and Wall smeared sources. We show that smeared sources improve the signal significantly, consequently we are able to improve the quality of results for a number of the phenomenologically interesting quantities. DOE

N92-24284# Los Alamos National Lab., NM.
CLASSICAL HADRODYNAMICS FOR EXTENDED NUCLEONS
B. W. Bush and J. R. Nix 1992 6 p Presented at the 8th Winter Workshop on Nuclear Dynamics, Jackson Hole, WY, 18-25 Jan. 1992
(Contract W-7405-eng-36)
(DE92-008482; LA-UR-92-611; CONF-920113-1) Avail: NTIS HC/MF A02

We discuss a new approach to relativistic nucleus-nucleus collisions based on classical hadrodynamics for extended nucleons, corresponding to nucleons of finite size interacting with massive meson fields. This theory provides a natural covariant microscopic approach to relativistic nucleus-nucleus collisions that includes automatically spacetime nonlocality and retardation, nonequilibrium phenomena, interactions among all nucleons, and particle production. Inclusion of the finite nucleon size cures the difficulties with preacceleration and runaway solutions that have plagued the classical theory of self-interacting point particles. DOE

N92-24295# Kansas State Univ., Manhattan. Dept. of Physics.
ATOMIC PHYSICS OF STRONGLY CORRELATED SYSTEMS
Chii-Dong Lin Jan. 1992 18 p
(Contract DE-FG02-86ER-13596)
(DE92-008218; DOE/ER-13596/26) Avail: NTIS HC/MF A03

This report presents the progress made in the continuing study of strongly correlated atomic systems within the last year. We have examined the shape of three-body systems in hyperspherical coordinates by studying the evolution of the density functions with the mass ratio of the particles in the system. We have calculated the ejected electron spectra from the autoionizing states formed in double capture processes in collisions of multiple charged ions with atoms. We have investigated the systematics and the propensity rules of radiative and Auger decay rates of high-lying doubly excited states. We have also studied ion-atom collisions for processes which pose great challenges to detailed theories, by looking into processes where the cross sections are small such as the excitation process in He(2+) + H collisions, or by looking into fine details such as the orientation parameters in excitation and charge transfer processes. DOE

N92-24558# Louisville Univ., KY. Dept. of Physics.
SPECTROSCOPIC STUDIES OF HYDROGEN COLLISIONS
J. Kielkopf 10 Dec. 1991 3 p
(Contract DE-FG05-85ER-13332)
(DE92-008752; DOE/ER-13332/T4) Avail: NTIS HC/MF A01

Low energy collisions involving neutral excited states of hydrogen are being studied with vacuum ultraviolet spectroscopy. Atomic hydrogen is generated by focusing an energetic pulse of ArF, KrF, or YAG laser light into a cell of molecular hydrogen, where a plasma is created near the focal point. The H2 molecules in and near this region are dissociated, and the cooling atomic hydrogen gas is examined with laser and dispersive optical spectroscopy. In related experiments, we are also investigating neutral H + O and H + metal-atom collisions in these laser-generated plasmas. DOE

N92-24583# Virginia Univ., Charlottesville.
ELECTROMAGNETIC INTERACTIONS WITH NUCLEONS AND NUCLEI
S. T. Thornton and R. M. Sealock 30 Oct. 1991 38 p
(Contract DE-FG05-89ER-40501)
(DE92-008108; DOE/ER-40501/T1) Avail: NTIS HC/MF A03

Our primary research effort continues to be at the LEGS project at Brookhaven National Laboratory. The LEGS facility has made a transition in the last year from a combination of experiment and facility construction to full time experimental work. The first experiment, photodisintegration of the deuteron with polarized gamma rays, is completed and partially published. A second experiment, He-3(gamma, NN), has also been completed and analysis has begun. We expect to begin two more experiments in the next year. Other research efforts are primarily related to CEBAF and this work is growing, since major CEBAF experimental equipment is now being constructed. We are heavily involved in the CLAS collaboration in Hall B which will build the CEBAF Large Acceptance Spectrometer. Our contributions to the CEBAF experimental program and equipment construction are described. The He-3(gamma, NN) experiment at LEGS was the second use, in a new format, of the University of Virginia Nucleon Detector System. It is now a fully developed system. We also describe a new area of instrument development, applications of waveshifting optical fibers to novel position sensitive detectors for neutral particles. DOE

N92-24536# Princeton Univ., NJ.
MEDIUM ENERGY SPIN PHYSICS WITH LASERS
G. D. Cates 1992 11 p
(Contract DE-FG02-90ER-40557)
(DE92-008138; DOE/ER-40557/2) Avail: NTIS HC/MF A03

During the first two years of this program, we have successfully investigated two new methods for the production of polarized muonic helium. This work was done at LAMPF in collaboration with a group from Syracuse University. Traditionally, polarized muonic helium has been formed by stopping polarized muons in unpolarized atoms. Unfortunately, because of depolarization in the muon cascade to the ground state, residual polarizations are only approximately 3 percent. The two methods we have developed both achieve much higher muon polarizations. To accomplish our goals, we first developed an appropriate muon beam for use with our small gas targets. During the summer of 1990, we stopped unpolarized negative muons in nuclear polarized He-3. The muons were polarized in the cascade to the ground state through the hyperfine interaction with the nucleus. The resulting muon polarizations were 7.2 +/- 0.8 percent for a 100 percent nuclear polarized target. While higher polarizations are clearly desirable for practical purposes, this experiment yielded important insights on spin interactions that occur in muonic atoms. Also, the ability to rapidly reverse the target polarization gave the experiment good sensitivity with minimal systematic effects. Last summer, we completed an experiment in which we polarized muonic helium by direct spin interaction with an optically pumped Rb vapor. In this technique, the muonic helium atom is polarized through a combination of charge exchange and spin exchange with the polarized valence electron of the Rb vapor. In contrast to the technique described in appendix A, the He-3 nuclei are not polarized. This last technique yielded dramatic polarizations approaching 50 percent. DOE

N92-24676# California Univ., Berkeley. Lawrence Berkeley Lab.
AN EXPERIMENTAL REVIEW OF HYPERON MAGNETIC MOMENTS
K. B. Luk Jan. 1992 9 p Presented at the International Symposium on Hypernuclear and Strange Particle Physics, Shimoda (Japan), 9-12 Dec. 1991
(Contract DE-AC03-76SF-00098)
(DE92-008316; LBL-31802; CONF-911208-4) Avail: NTIS HC/MF A02

Hyperon magnetic moments are important probes for studying the structure of baryons. In this talk, I shall briefly describe how the measurements are made and discuss the current status of the determinations. DOE

N92-24684# Westinghouse Hanford Co., Richland, WA.
BREMCALC: A COMPUTER PROGRAM FOR CALCULATING ELECTRON AND POSITRON BREMSSTRAHLUNG
P. D. Rittmann Jan. 1992 8 p Presented at the Meeting on New Horizons in Radiation Protection and Shielding, Pasco, WA, 26 Apr. - 1 May 1992
(Contract DE-AC06-87RL-10930)
(DE92-006496; WHC-SA-1435; CONF-920431-9) Avail: NTIS HC/MF A02

A personal computer program to calculate electron and positron bremsstrahlung spectra using methods similar to those incorporated in the earlier BREMRAD program is now available. The program will handle beta decay and positron emission, as well as single energy electrons such as those produced by internal conversion. This program, called BREMCALC, will also calculate bremsstrahlung from single energy positrons. Program output options include whether to display differential spectra or total photon production in each energy range, such as that needed for input to a gamma-shielding program such as ISOSHLD. This paper summarizes the quantum mechanical models, the input data needed to run a case, and comparisons of program output with previous work. DOE

N92-24693# Los Alamos National Lab., NM.
SIMULATIONS OF SECOND-ORDER FERMI ACCELERATION OF ELECTRONS: SOLVING THE INJECTION PROBLEM
G. R. Gisler 1991 7 p Presented at the Particle Acceleration in Cosmic Plasmas Conference, Newark, DE, 2-4 Dec. 1991
(Contract W-7405-eng-36)
(DE92-008494; LA-UR-92-519; CONF-9112103-1) Avail: NTIS HC/MF A02

The boosting of electrons from a Maxwellian distribution into a suprathermal power-law tail has long been recognized as an important bottleneck governing the subsequent acceleration of some of these electrons to relativistic energies. This is the seed or injection problem. I study this boosting process using a test-particle simulation code, following the full equations of motion of tens of thousands of electrons chosen from a thermal population as they move through general time-dependent magnetic fields. Inhomogeneities in the magnetic field are provided by finite swarms of moving current loops with Maxwellian velocity distributions and power-law distributions of loop size and dipole moment strength. Whether bulk heating or boosting occurs is found to depend on the size of the swarm thermal speed compared to the electron thermal speed. When the swarm thermal speed is comparable to the electron thermal speed the entire electron population is heated by encounters with the rapidly moving current loops, approximately preserving the Maxwellian character of the electron distribution. On the other hand, at very low swarm thermal speeds there is no bulk heating; instead one percent or fewer of the electrons are boosted into a power-law suprathermal tail with a differential energy spectral index between 1 and 2. Individual boosts of 2000 and more have been observed in samples of 50,000 electrons. Most of the strongly boosted electrons have initial energies that are well below the peak of the initial Maxwellian. DOE

N92-24694# Middle Tennessee State Univ., Murfreesboro. Dept. of Chemistry and Physics.
NUCLEAR STRUCTURE STUDIES VIA NEUTRON INTERACTIONS
R. F. Carlton Jan. 1992 28 p
(Contract DE-FG05-86ER-40293)
(DE92-008517; DOE/ER-40293/6) Avail: NTIS HC/MF A03

Research performed consisted of publication of a theoretical paper for the n + Ar-40 system; submission of a paper on the R-matrix analysis of the neutron total cross section data for the n + Pb-208 system, up to an energy of 1.7 MeV; extension of the analysis of neutron scattering and total cross section data for n + Fe-54 up to an energy of 1 MeV, with J(sup pi) values confirmed in most cases by differential scattering data; porting of most of the analysis programs used in the research program to the RISC/6000 workstation. DOE

N92-24699# Texas Univ., Austin.
EXCITATION OF SOLITONS BY AN EXTERNAL RESONANT WAVE WITH A SLOWLY VARYING PHASE VELOCITY
I. Aranson, B. Meerson (Hebrew Univ., Jerusalem, Israel), and Toshiki Tajima Feb. 1992 36 p
(Contract DE-FG05-80ET-53088)
(DE92-008588; DOE/ET-53088/536; IFSR-536) Avail: NTIS HC/MF A03

A novel mechanism is proposed for the excitation of solitons in nonlinear dispersive media. The mechanism employs an external pumping wave with a varying phase velocity, which provides a continuous resonant excitation of a nonlinear wave in the medium. Two different schemes of a continuous resonant growth (continuous phase locking) of the induced nonlinear wave are suggested. The first of them requires a definite time dependence of the pumping wave phase velocity and is relatively sensitive to the initial wave phase. The second employs the dynamic autoresonance effect and is insensitive to the exact time dependence of the pumping wave phase velocity. It is demonstrated analytically and numerically, for a particular example of a driven Korteweg-de Vries (KdV) equation with periodic boundary conditions, that as the nonlinear wave grows, it transforms into a soliton, which continues growing and accelerating adiabatically. A fully nonlinear perturbation theory

is developed for the driven KdV equation to follow the growing wave into the strongly nonlinear regime and describe the soliton formation. DOE

N92-24879# California Univ., Irvine.
GAMMA RAY AND NEUTRINO DETECTOR FACILITY (GRANDE), TASK C
H. W. Sobel and G. B. Yodh Aug. 1991 20 p
(Contract DE-AM03-76SF-00010)
(DE92-008145; DOE/SF-00010/T3) Avail: NTIS HC/MF A03

GRANDE is an imaging, water Cerenkov detector. GRANDE combines an extensive air shower array and a high-energy neutrino detector in one facility. It is proposed that the detector be constructed in phases, beginning with an active detector area of 31,000 sq m (GRANDE-I)(sup 2) and expanding to a final size of 100,000 - 150,00 sq m. Some of the characteristics of GRANDE-I are discussed in this paper. DOE

N92-24884# Illinois Univ., Urbana. Physics Lab.
THE TAU CHARM FACTORY: PROSPECTS FOR OPEN CHARM AND TAU PHYSICS
J. M. Izen 1991 8 p Presented at the 4th Conference on the Intersections Between Particle and Nuclear Physics, 23-29 May 1991
(Contract DE-AC02-76ER-01195)
(DE92-008226; UIUC-HEPG-91-81; CONF-9105106-37) Avail: NTIS HC/MF A02

A high luminosity e(+)e(-) collider is proposed to explore decays of charmed mesons, tau leptons, and charmonia. Extremely large event samples will give precision measurements of the absolute branching fraction and structure of hadronic, semileptonic, and leptonic charmed meson decay. Tau pair events will be used to study the properties of tau decay, and to measure the mass of the tau neutrino. DOE

N92-25018# Boston Univ., MA. Dept. of Physics.
RESEARCH ACCOMPLISHMENTS AND FUTURE GOALS IN PARTICLE PHYSICS
Dec. 1991 227 p
(Contract DE-AC02-89ER-40509)
(DE92-008219; DOE/ER-40509/3) Avail: NTIS HC/MF A11

This report presents the research accomplishments and ongoing activities of Boston University researchers in high energy physics. We are active in eight principal areas which are discussed in this report: Colliding Beams - physics of electron-positron annihilation; Accelerator Design Physics - advanced accelerator design; Monopole/ Neutrino - searchers for magnetic monopoles and for neutrino oscillations; Proton Decay - search for nucleon instability and study of nonaccelerator physics; Particle Theory - theoretical high energy particles physics; Muon G-2 - an experiment to measure the anomalous magnetic moment of the muon with a factor of 20 better precision than currently achieved; SSCintcal - scintillating fiber calorimetry for the SSC; and SSC Muon Detectors - development of muon detectors for the GEM Experiment at the SSC. DOE

N92-25025# Ohio Univ., Athens. Dept. of Physics.
COULOMB EFFECTS IN QUASIELASTIC ELECTRON SCATTERING
D. S. Onley 1991 6 p Presented at the 8th Seminar on Electromagnetic Interactions of Nuclei at Low and Medium Energies, Moscow (USSR), 2-5 Dec. 1991
(Contract DE-FG02-87ER-40370)
(DE92-007498; CONF-9112101-1) Avail: NTIS HC/MF A02

Coulomb distortion plays an important role in interpreting both (e,e(prime)) and (e,e,(prime)p) reactions in the quasielastic region. A fully distorted partial wave calculation is presented, and the results are compared with the widely-used plane wave approximation and other distorted-wave calculations. The new calculation seems to give higher occupation numbers in the (e,e(prime)p) reactions. The usefulness of the (e,e(prime)p) reaction in studying different nuclear optical potentials is discussed. Also considered are the effects of electron Coulomb distortion in the separation of longitudinal and transverse structure functions in (e,e(prime)). DOE

N92-25026# California Univ., Berkeley. Lawrence Berkeley Lab.
PION INTERFEROMETRY AND RESONANCES IN pp AND AA COLLISIONS
S. S. Padula and M. Gyulassy 10 Dec. 1991 6 p Presented at the Quark Matter 1991, Gatlinburg, TN, 11-15 Nov. 1991
(Contract DE-AC03-76SF-00098)
(DE92-008306; LBL-31607; CONF-9111165-8) Avail: NTIS HC/MF A02

We study the sensitivity of pion interferometry in proton-proton and antiproton-proton collisions at ISR energies to the resonance abundance. We show that those data are not compatible with the full resonance fractions predicted by the Lund model. The preliminary S+S and O+Au data at 200 GeV are, however, not incompatible with the Lund predictions, although their sensitivity to resonances is significantly weaker than in the proton-proton/antiproton-proton case. DOE

N92-25031# International Centre for Theoretical Physics, Trieste (Italy).
A COVARIANT CANONICAL DECOMPOSITION OF THE BOSONIC AND SPINNING EXTENDED OBJECTS WITH ELECTRIC CHARGE
A. O. Barut and M. Pavsic Oct. 1991 11 p
(DE92-619256; IC-91/365) Avail: NTIS HC/MF A03

By introducing a time-like vector field n(sup a) (hence a choice of an invariant time parameter (tau)) the action of a spinning extended object in d-dimensions can be covariantly decomposed into the analog of a center of mass part and a space-like internal part. In this way the action has the same form as that of a point particle which is convenient for the interpretation of the theory, its covariant canonical quantization, and for the definition of the form factors. DOE

N92-25040# California Univ., Irvine.
SINGLE-COLLISION STUDIES OF HOT ATOM ENERGY TRANSFER AND CHEMICAL REACTION
J. J. Valentini (Columbia Univ., New York, NY.) 1991 11 p
(Contract DE-FG03-85ER-13453)
(DE92-007961; DOE/ER-13453/T1) Avail: NTIS HC/MF A03

This report discusses research in the collision dynamics of translationally hot atoms, with funding with DOE for the project, Single-Collision Studies of Hot Atom Energy Transfer and Chemical Reaction, Grant Number DE-FG03-85ER-13453. The work reported here was done during the period 9 Sep. 1988 through 31 Oct. 1991. During this period, the work has been focused on several different efforts: (1) experimental studies of the state-to-state dynamics of the H + RH yields H2 R reactions where RH is CH4, C2H6, or C3H8; (2) theoretical (quasiclassical trajectory) studies of hot hydrogen atom collision dynamics; (3) the development of photochemical sources of translationally hot molecular free radicals and characterization of the high resolution CARS spectroscopy of molecular free radicals; and (4) the implementation of stimulated Raman excitation (SRE) techniques for the preparation of vibrationally state-selected molecular reactants. DOE

N92-25053# Florida Univ., Gainesville. Inst. for Fundamental Theory.
NEUTRINOLOGY
P. Ramond 1991 41 p
(Contract DE-FG05-86ER-40272)
(DE92-008778; DOE/ER-40272/141; UFIFT-HEP-91-28) Avail: NTIS HC/MF A03

We present various topics of theoretical and experimental interest in the search for signals of massive neutrinos. We discuss implications of massive neutrinos for model building beyond the Standard Model. We emphasize one example where the scale of

lepton number breaking is linked to that of the breaking of the axion symmetry. DOE

N92-25060# Oak Ridge National Lab., TN.
IONIC POLARIZATION
G. D. Mahan (Tennessee Univ., Knoxville.) Feb. 1992 11 p Presented at the 2nd Williamsburg Conference on Ferroelectrics, Williamsburg, VA, 3-4 Feb. 1992
(Contract DE-AC05-84OR-21400)
(DE92-008007; CONF-920267-1) Avail: NTIS HC/MF A03

Ferroelectricity occurs in many different kinds of materials. Many of the technologically important solids, which are ferroelectric, can be classified as ionic. Any microscopic theory of ferroelectricity must contain a description of local polarization forces. We have collaborated in the development of a theory of ionic polarization which is quite successful. Its basic assumption is that the polarization is derived from the properties of the individual ions. We have applied this theory successfully to diverse subjects as linear and nonlinear optical response, phonon dispersion, and piezoelectricity. We have developed numerical methods using the local density approximation to calculate the multipole polarizabilities of ions when subject to various fields. We have also developed methods of calculating the nonlinear hyperpolarizability, and showed that it can be used to explain light scattering experiments. This paper elaborates on this polarization theory. DOE

N92-25117# Los Alamos National Lab., NM.
DECAY PROPERTIES OF NUCLEI AT THE END OF THE PERIODIC SYSTEM
P. Moeller (Japan Atomic Energy Research Inst., Ibaraki.) and J. R. Nix 24 Jan. 1992 35 p Presented at the Nuclear Structure and Reactions Using Unstable Nuclei Conference, Riken, Japan, 27-29 Jan. 1992
(Contract W-7405-eng-36)
(DE92-008483; LA-UR-92-612; CONF-920190-1) Avail: NTIS HC/MF A03

Recent studies of nuclear mass models show that it is essential to account for the Coulomb redistribution energy when calculating the nuclear potential energy in the heavy element region. Results obtained by use of a mass model that includes Coulomb redistribution effects on analyzed. Q values of alpha and beta decay are calculated. Half-lives for alpha decay are estimated by use of the Viola-Seaborg systematics. For EC, beta(+) decay and beta(-) decay, half-lives are calculated in a microscopic QRPA model. Calculated single-particle level structures in the heavy element regions are presented. These indicate possible regions of isomers that would be unusually stable with respect to spontaneous fission and alpha decay. Finally, we discuss the implications of earlier extensive work on fission properties of nuclei in this region. DOE

N92-24808*# Boeing Co., Seattle, WA. Defense and Space Group.
ATOMIC OXYGEN AND ULTRAVIOLET RADIATION MISSION TOTAL EXPOSURES FOR LDEF EXPERIMENTS
R. J. Bourassa, J. R. Gillis, and Ken W. Rousslang (Puget Sound Univ., Tacoma, WA.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 643-661 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 20H

N92-24810*# Army Materials Technology Lab., Watertown, MA.
MEASUREMENT OF THE O-18 TO O-16 ISOTOPE RATIO FOR CHARACTERIZING OXIDE SURFACE LAYERS ON LDEF SAMPLES
Paul L. Sagalyn *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 679-686 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 20H

N92-24815*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
INTERACTIONS OF ATOMIC OXYGEN WITH MATERIAL SURFACES IN LOW EARTH ORBIT: PRELIMINARY RESULTS FROM EXPERIMENT A0114 Abstract Only
John C. Gregory, Ligia C. Christl, Ganesh N. Raikar, J. J. Weimer, R. Wiser (Alabama Univ., Huntsville.), and Palmer N. Peters *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 753 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 20H

N92-24817*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
LDEF EXPERIMENT A0034: ATOMIC OXYGEN STIMULATED OUTGASSING
Roger C. Linton, Rachel R. Kamenetzky, John M. Reynolds, and Charles L. Burris (Southern Univ., Baton Rouge, LA.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 763-779 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 20H

N92-24818*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ATOMIC OXYGEN UNDERCUTTING OF LDEF ALUMINIZED-KAPTON MULTILAYER INSULATION
Kim K. deGroh and Bruce A. Banks *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 781-795 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 20H

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N92-24213# Superconducting Super Collider Lab., Dallas, TX.
COMPENSATION OF COUPLING IN THE SSC COMPLEX
F. Pilat and G. Bourianoff Oct. 1991 6 p Presented at the 5th International Committee for Future Accelerators (ICFA) Beam Dynamics Workshop, Corpus Christi, TX, 3-8 Oct. 1991 Submitted for publication
(Contract DE-AC35-89ER-40486)
(DE92-007649; SSCL-Preprint-22; CONF-9110243-14) Avail: NTIS HC/MF A02

This paper describes a study of coupling effects and their compensation by means of local depending techniques for some of the accelerators in the SSC Complex. Results concerning corrections and decoupling for the Low Energy and Medium Energy Boosters are compared to results obtained for the Collider Ring. Some preliminary experimental data about measurement of coupling quantities is also presented. DOE

N92-24287# Superconducting Super Collider Lab., Dallas, TX.
BRIEF COMMENT ON ONE-TURN MAPS FOR LONG-TERM TRACKING
Y. T. Yan Oct. 1991 3 p Presented at the 5th International Committee for Future Accelerators (ICFA) Beam Dynamics Workshop, Corpus Christi, TX, 3-8 Oct. 1991 Submitted for publication
(Contract DE-AC35-89ER-40486)
(DE92-007650; SSCL-Preprint-16; CONF-9110243-13) Avail: NTIS HC/MF A01

There is doubt that one-turn maps are valuable for analysis of short-term beam dynamics. However, it is a controversial issue as to whether one can use a one-turn map for long-term tracking of large storage rings and thereby save enormous computer time. Based on some recent works, the author wishes to state tentatively

that for certain cases - in particular, for the Superconducting Super Collider (SSC) dynamic aperture study - one-turn-map trackings can be made nearly as reliable as element-by-element trackings. The author also wishes to make the following general statement: If a one-turn map is symplectic and accurate to five or more digits in one-turn tracking for the phase-space coordinates of particles within the interest region (inside or around the dynamic aperture), then the one-turn map is nearly as reliable as its associated element-by-element tracking for predicting the 'global' long-term stability of the storage ring. DOE

N92-24552# Argonne National Lab., IL.
THE ADVANCED PHOTON SOURCE Status Report
D. M. Mills Jan. 1992 19 p Presented at the 7th National Conference and Exhibition on Synchrotron Radiation Instrumentation, Baton Rouge, LA, 28-31 Oct. 1991
(Contract W-31-109-eng-38)
(DE92-009730; ANL/CP-74462; CONF-9110146-14) Avail: NTIS HC/MF A03

The Advanced Photon Source (APS) currently under construction at Argonne National Laboratory is scheduled for completion in early 1996. Both conventional facilities construction and technical fabrication is well underway. An update on the current state of civil construction as well as progress on storage ring and beamline technical component development will be presented. User activities have also proceeded at a rapid pace, particularly over the last year. In response to a call for Proposals for sectors, the APS received proposals for over twenty sectors from prospective Collaborative Access Teams (CATs). It is anticipated that beamline construction in the experiment hall could begin in approximately 18 months. DOE

N92-24553# Sandia National Labs., Albuquerque, NM.
RECENT CODE STUDIES OF RLA, BOLT, AND THE 100 MV DIODE
J. W. Poukey Feb. 1992 51 p
(Contract DE-AC04-76DP-00789)
(DE92-009880; SAND-91-2605) Avail: NTIS HC/MF A04

The 2-D code MAGIC and TRAJ have been used for extensive studies of diode, IFR channel, and accelerating gap problems in the recirculating linear accelerator (RLA). Typical beam parameters use 10-20 kA, 3-4 MeV. This report summarizes recent results from these simulations. We have also designed possible injectors for the proposed BOLT experiment, with typical beams at 100 A, 1.0-1.5 MeV. Finally, we discuss some preliminary diode runs of proposed 100 MV, 500 kA accelerator using the SMILE/HERMES method of adding voltages from many cavities across a single immersed diode gap. DOE

N92-24559# Notre Dame Univ., IN. Dept. of Physics.
RESEARCH IN HIGH ENERGY PHYSICS
J. LoSecco 1992 25 p
(Contract DE-FG02-91ER-40623)
(DE92-008764; DOE/ER-40623/1) Avail: NTIS HC/MF A03

This report discusses: Proton Decay; Point Source Search; Underground Muons from Cygnus X3; Dark Matter; Neutrino Oscillations; The Future of IMB; and Meson Spectroscopy. DOE

N92-24575# Lawrence Livermore National Lab., CA.
A SYSTEM FOR THE TOMOGRAPHIC DETERMINATION OF THE POWER DISTRIBUTION IN ELECTRON BEAMS
A. Teruya, J. Elmer, and D. OBrien Dec. 1991 18 p Presented at the 8th Conference on State-of-the-Art Electron Beam Melting and Refining, Reno, NV, 13-15 Nov. 1991
(Contract W-7405-eng-48)
(DE92-008621; UCRL-JC-108829; CONF-911189-2) Avail: NTIS HC/MF A03

A computer tomographic technique was developed to measure the current density distribution in electron beams. This technique uses electron-beam profile data acquired from a modified Faraday cup to create an image of the current density in high power beams. The beam profile data is acquired by sweeping the beam across a narrow slit. The beam current, integrated along the axis of the slit, is captured by a Faraday cup and its waveform is recorded by a digitizing storage oscilloscope. The slit is repeatedly rotated and beam current waveforms are recorded at regularly spaced angles. A 2-dimensional image of the current density distribution in the beam is reconstructed from this information, providing quantitative information about the beam focus and alignment. This paper discusses the techniques used to record beam profiles and the computer tomographic reconstruction of beams. An example of how this method can be used to control beam focus in an unbiased way is presented. DOE

N92-24582# Sandia National Labs., Albuquerque, NM.
THE 90 METER EPOCH PROPAGATION EXPERIMENTS
J. R. Smith, I. R. Shokair, P. Kiekel, I. Molina, B. N. Turman, and K. W. Struve (Mission Research Corp., Albuquerque, NM.) 1991 7 p Presented at the Charged Particle Beam Conference, Silver Springs, MD, 25-27 Jun. 1991
(Contract DE-AC04-76DP-00789)
(DE92-009055; SAND-92-7071C; CONF-9106276-8) Avail: NTIS HC/MF A02

Propagation of a 1 microsecond electron beam over a distance of 90 m has been investigated in the EPOCH Laboratory at Sandia National Laboratories. The mode of propagation is ion focused regime (IFR) transport. The plasma channel, which is required for IFR transport, is obtained by photoionization of trimethylamine gas with a krypton-fluoride laser. Beam voltage is 2.5 MV, and beam current is 1-2 kA. Propagation efficiencies better than 90 percent have been recorded. The ion hose instability is a key issue concerning long-pulse beam propagation. In previous work, growth of transverse beam oscillations (due to the ion hose instability) and moderate damping (due to phase-mixing) were measured in the first 6 m of beam propagation. Detailed displacement measurements in this region were used to determine the ion hose growth rate. Damping of beam oscillations is accompanied by an increase in beam radius as measured from head to tail. Measurement of radius growth has been one of the key tasks of FY 91. Several new features which improve these radius measurements as compared to those taken in FY 90 are: slice radius growth measured on a single shot; improved accuracy due to reduction in camera to target distance; improved accuracy due to diagnostic calibrations; and improved software analysis. The recent measurements may be separated into two categories, each characterized by different beam parameters. Category 1 has an initial radius of 1-2 cm and a peak current of 1.1 kA. The initial radius for Category 2 has not yet been measured; we estimate that it lies in the range from 2-3 cm. Category 2 peak current is 1.6 kA. The space charge neutralization (channel strength) used in obtaining data for both cases is in the range 0.5 less than f less than 1.3. DOE

N92-24718# Lawrence Livermore National Lab., CA.
MOLE: A NEW HIGH-ENERGY GAMMA-RAY DIAGNOSTIC
M. J. Moran and B. Chang 21 Jan. 1992 12 p
(Contract W-7405-eng-48)
(DE92-009742; UCRL-ID-109712) Avail: NTIS HC/MF A03

Continued interest in high-energy gamma rays associated with fusion reactions has motivated an ongoing search for simple, effective measurement techniques. Past experiments have measured 16.7-MeV gamma rays with Compton-magnetic spectrometers. Some measurements have been performed with threshold Cherenkov detectors with enhanced sensitivity to high-energy (gamma) rays. The Compton spectrometers work quite well, but they require extensive calibrations and tend to be expensive and cumbersome. The threshold Cherenkov detectors are simpler to calibrate and physically compact, but have poor spectral definition and are vulnerable to background signals. This report describes a new type of (gamma)-ray detector, the MOLE, that may retain the simplicity of a threshold Cherenkov detector while still having sufficient energy discrimination to be effective for measuring high-energy (gamma)-rays in the presence of lower-energy (gamma)-ray fluxes. DOE

N92-24886# Illinois Univ., Urbana.
ELECTRICAL ENGINEERING STANDARDS FOR THE NEXT GENERATION OF HIGH ENERGY PHYSICS EXPERIMENTS
R. Downing 1991 12 p Presented at the LeCroy Conference on Electronics for Future Colliders, Chestnut Ridge, NY, 22 May 1991
(Contract DE-AC02-76ER-01195)
(DE92-008227; UIUC-HEPG-91-82; CONF-9105187-4) Avail: NTIS HC/MF A03

This paper reviews the history of standards for physics data acquisition systems. The future need for electrical, software, and design standards in the next generation of detectors is discussed. Much of this paper is based on the views of the author as to the future directions that need to be taken for success of these very complex systems which are being proposed for High Energy Physics. DOE

N92-24896# Argonne National Lab., IL. High Energy Physics Div.
THERMODYNAMICS OF LATTICE QCD WITH 2 LIGHT DYNAMICAL (STAGGERED) QUARK FLAVOURS ON A 16(EXP 3) (TIMES) 8 LATTICE
S. Gottlieb, A. Krasnitz, U. M. Heller, A. D. Kennedy, and J. B. Kogut (Illinois Univ., Urbana.) 1991 3 p Presented at the LATTICE 91, Tsukuba, Japan, 5-9 Nov. 1991
(Contract W-31-109-eng-38)
(DE92-009731; ANL-HEP-CP-92-4; CONF-9111179-3) Avail: NTIS HC/MF A01

Lattice QCD with 2 light staggered quark flavours is being simulated on a 16(exp 3) times 8 lattice to study the transition from hadronic matter to a quark gluon plasma. We have completed runs at m(sub q) = 0.0125 and are extending this to m(sub q) = 0.00625. We also examine the addition of a non-dynamical 'strange' quark. Thermodynamic order parameters are being measured across the transition and further into the plasma phase, as are various screening lengths. No evidence for a first order transition is seen, and we estimate the transition temperature to be (Tc) = 143(7)MeV. DOE

N92-24981*# Chicago Univ., IL.
ANALYZING HIGH ENERGY PHYSICS DATA USING DATABASE COMPUTING: PRELIMINARY REPORT
Andrew Baden, Chris Day, Robert Grossman, Dave Lifka, Ewing Lusk, Edward May, and Larry Price Dec. 1991 17 p
(Grant NAG2-513)
(NASA-CR-190332; NAS 1.26:190332) Avail: NTIS HC/MF A03 CSCL 20C

A proof of concept system is described for analyzing high energy physics (HEP) data using data base computing. The system is designed to scale up to the size required for HEP experiments at the Superconducting SuperCollider (SSC) lab. These experiments will require collecting and analyzing approximately 10 to 100 million 'events' per year during proton colliding beam collisions. Each 'event' consists of a set of vectors with a total length of approx. one megabyte. This represents an increase of approx. 2 to 3 orders of magnitude in the amount of data accumulated by present HEP experiments. The system is called the HEPDBC System (High Energy Physics Database Computing System). At present, the Mark 0 HEPDBC System is completed, and can produce analysis of HEP experimental data approx. an order of magnitude faster than current production software on data sets of approx. 1 GB. The Mark 1 HEPDBC System is currently undergoing testing and is designed to analyze data sets 10 to 100 times larger. Author

N92-25021# Lehigh Univ., Bethlehem, PA.
STUDY OF MULTIPARTICLE JET PRODUCTION USING CALORIMETERS, HIGH ENERGY CHANNELING, AND OTHER HIGH ENERGY PHYSICS RESEARCH
A. S. Kanofsky 1991 12 p
(Contract DE-AC02-76ER-02894)
(DE92-008245; DOE/ER-02894/4) Avail: NTIS HC/MF A03

A series of experiments to measure single and dijet cross sections on both nuclear and proton targets were performed at Fermilab. Experiments to measure the properties of high energy channeling were performed at Brookhaven and Fermilab. An experiment to measure particle nuclei interactions was performed using the Argonne Streamer Chamber facility. Also, measurements of radiation effects on various devices were performed using the Lehigh Van de Graaff facility. Calculations on single and multiple quark scattering were performed using the Glauber model and Monte Carlo models. Studies were performed on experimental facilities and experiments for ISABELLE and the SSC, and work continues on experiments and apparatus for Fermilab, the SSC, and other accelerator facilities. DOE

N92-25039# California Univ., Berkeley. Lawrence Berkeley Lab.
PUTTING SYNCHROTRON RADIATION TO WORK FOR TECHNOLOGY: ANALYTIC METHODS
Feb. 1992 203 p Presented at the Putting Synchrotron Radiation to Work for Technology: Analytic Methods, Berkeley, CA, 17 Jan. 1992
(Contract DE-AC03-76SF-00098)
(DE92-009146; LBL-31851; CONF-920160-Summ) Avail: NTIS HC/MF A10

This report contains viewgraphs on: advanced light source; ultra-ESCA - advanced capabilities of XPS with high-brightness synchrotron radiation; high-resolution (20 nm) XPS and XANES with the ALS; photoelectron spectroscopy in industry - current capabilities, needs, and possible roles for the ALS; materials analysis by photoemission; applications of long-wavelength x-ray fluorescence spectrometry; and x-ray powder diffractometry. DOE

N92-25041# Johns Hopkins Univ., Baltimore, MD. Dept. of Physics and Astronomy.
RESEARCH IN THEORETICAL PHYSICS
G. Domokos and S. Kovesi-Domokos Nov. 1991 7 p
(Contract DE-FG02-85ER-40211)
(DE92-007999; DOE/ER-40211/7) Avail: NTIS HC/MF A02

We propose the continuation of the research under this grant. We propose to extend the search for signatures of 'new physics' to new processes. In particular, we want to investigate extensions of the search to hadronic reactions. The appearance of anomalous terms in the matrix elements of SU(3)(sub color) currents, indicating the presence of 'new physics' in the quark sector of the Standard Model, can be studied by following the jet evolution and hadronization. The effect is expected to be rather large in top quark initial state gluon Bremsstrahlung, thus colliders are a good testing ground for the presence of 'new physics' even at Tevatron energies. We continue the study of astro-particle physics. We propose to investigate further the structure of extensive air showers associated with point sources in the sky. We propose to study neutrino production in the Milky Way: this will enable us both to estimate the background of neutrino telescopes and to search for the presence of baryonic dark matter in the galactic halo. DOE

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers*.

N92-24203*# McCrone Associates, Inc., Westmont, IL.
CONTAMINATION ANALYSES OF TECHNOLOGY MIRROR ASSEMBLY OPTICAL SURFACES
Mark S. Germani 30 Sep. 1991 20 p
(NASA Order H-11269-D)
(NASA-CR-184311; NAS 1.26:184311; MA-20710FR) Avail: NTIS HC/MF A03 CSCL 20F

Automated electron microprobe analyses were performed on tape lift samples from the Technology Mirror Assembly (TMA) optical surfaces. Details of the analyses are given, and the contamination of the mirror surfaces is discussed. Based on the automated analyses of the tape lifts from the TMA surfaces and the control blank, we can conclude that the particles identified on

the actual samples were not a result of contamination due to the handling or sampling process itself and that the particles reflect the actual contamination on the surface of the mirror. Author

N92-24796*# Beloit Coll., WI. Dept. of Physics and Astronomy.
OPTICS ALIGNMENT PANEL Final Report, 1 Jun. 1991 - 29 Feb. 1992
Daniel J. Schroeder 1992 88 p
(Grant NAG5-1620)
(NASA-CR-190139; NAS 1.26:190139) Avail: NTIS HC/MF A05 CSCL 20F

The Optics Alignment Panel (OAP) was commissioned by the HST Science Working Group to determine the optimum alignment of the OTA optics. The goal was to find the position of the secondary mirror (SM) for which there is no coma or astigmatism in the camera images due to misaligned optics, either tilt or decenter. The despace position was reviewed of the SM and the optimum focus was sought. The results of these efforts are as follows: (1) the best estimate of the aligned position of the SM in the notation of HDOS is (DZ,DY,TZ,TY) = (+248 microns, +8 microns, +53 arcsec, -79 arcsec), and (2) the best focus, defined to be that despace which maximizes the fractional energy at 486 nm in a 0.1 arcsec radius of a stellar image, is 12.2 mm beyond paraxial focus. The data leading to these conclusions, and the estimated uncertainties in the final results, are presented. Author

N92-25016 National Physical Lab., Teddington (England). Div. of Mechanical and Optical Metrology.
PREPARATION AND POLISHING OF THE ENDS OF MONOMODE OPTICAL FIBRES FOR OPTIMUM TRANSMITTANCE
M. S. Virdee Feb. 1992 20 p
(NPL-MOM-108; ETN-92-91724) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0 LW, England

A simple and reliable technique for preparing the ends of monomode optical fibers using a novel polishing method is described. This technique was developed to obtain easily and repeatably intensity transmission efficiencies of between 60 and 80 pct. The method used to assemble the fibers, details of the polishing, and the assessment of the performance of the polished fibers are described. The polishing of the types of fibers is considered. ESA

N92-25108# Lawrence Livermore National Lab., CA.
FINAL OPTICS FOR LASER-DRIVEN INERTIAL FUSION REACTORS
J. G. Woodworth, L. L. Chase, M. W. Guinan, W. F. Krupke, and W. R. Sooy 2 Oct. 1991 5 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract W-7405-eng-48)
(DE92-008617; UCRL-JC-108464; CONF-910968-70) Avail: NTIS HC/MF A01

If Inertial Confinement Fusion (ICF) power plus utilizing laser drivers are to be considered for electrical power generation, a method for delivering the driver energy into the reactor must be developed. This driver-reactor interface will necessarily employ 'final optics,' which must survive in the face of fast neutrons, x rays, hot vapors and condensates, and high speed droplets. The most difficult to protect against is fast neutron damage since no optically transmissive shielding material for 14 MeV neutrons is available. Multilayer dielectric mirrors are judged to be unsuitable because radiation induced chemical change, diffusion, and thickness changes will destroy their reflectivity within a few months of plant operation. Recently, grazing incidence metal mirrors were proposed, but optical damage issues are unresolved for this approach. In this study, we considered the use of refractive optics. A baseline design consists of two wedges of fused silica, which put a dogleg into the beam and thus remove optics further upstream from direct sight of the reactor. If the closest optic were located 40 m from the center of a 3 GW sub t reactor it would be subject to an average 14 MeV neutron flux of approx. 5 x 10(exp 12) n/sq cm with a peak flux of approx. 6 x 10(exp 18) n/sq cm. A major question to be answered is: 'what duration of reactor operation can this optic withstand'. To answer this question we have reviewed the literature bearing on radiation induced optical damage in fused silica and assessed its implications for reactor operation with the baseline final optics scheme. It appears possible to continuously anneal the neutron damage in the silica by keeping the wedge at a modestly elevated temperature. DOE

N92-25131# National Inst. of Standards and Technology, Gaithersburg, MD.
THREE DIMENSIONAL RECONSTRUCTION FROM OPTICAL FLOW USING TEMPORAL INTEGRATION
R. Rangachar, T. H. Hong, M. Herman, and R. Luck (Aspex, Inc., New York, NY.) Apr. 1991 14 p Prepared in cooperation with American Univ., Washington, DC
(PB92-112507; NISTIR-4570) Avail: NTIS HC/MF A03 CSCL 20F

Image flow, the apparent motion of brightness patterns on the image plane, can provide important visual information such as distance, shape, surface orientation, and boundaries. It can be determined by either feature tracking or spatio-temporal analysis. The optical flow thus determined can be used to reconstruct the 3-D scene by determining the depth from camera of every point in the scene. However, the optical flow determined by either of the methods mentioned above will be noisy. As a result, the depth information obtained from optical flow can not be successfully used in practical applications such as image segmentation, 3-D reconstruction, path planning, etc. By using temporal integration, the accuracy of both the optical flow and the depth determined from optical flow can be increased. An incremental integration scheme is described called the running average method to temporally integrate the image flow. They integrate the depth from camera obtained using optical flow determined from gradient based methods, and show that the results of temporal integration are much more useful in practical applications than the results from local edge operators. Image segmentation is also considered. Author

N92-24475# British Aerospace Public Ltd. Co., Stevenage (England).
A FIBRE OPTIC IMPLEMENTATION OF MACS BUS
D. J. Morris, M. J. Baker, F. v.Fischer-Treuenfeld, H. G. Sparringa, and P. Brazzale (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Spacecraft Guidance, Navigation and Control Systems Dec. 1991 p 315-319 (For primary document see N92-24432 15-18)
Copyright Avail: NTIS HC/MF A99

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N92-24222# Wisconsin Univ., Madison. Torsatron/Stellarator Lab.
THE UNIVERSITY OF WISCONSIN-MADISON TORSATRON/STELLARATOR LABORATORY PROGRAM, FY 1991 - 1993
J. L. Shohet, D. T. Anderson, F. S. B. Anderson, and J. N. Talmadge Sep. 1991 19 p
(Contract DE-FG02-86ER-53216)
(DE92-007021; DOE/ER-53216/5) Avail: NTIS HC/MF A03

This document summarizes results obtained during the first eight months of the current three year grant for research at the University of Wisconsin-Madison Torsatron/Stellarator Laboratory (TSL) and presents plans for future activity during fiscal years 1992 and 1993. Research efforts have focused on fundamental physics issues associated with toroidal confinement, predominantly through experimental investigations on the Interchangeable Module Stellarator (IMS). The program direction was guided into studies

of fluctuations, potentials and electric fields, plasma currents and flows, and effects of magnetic islands by a desire for increased relevance and impact on the general toroidal confinement program. Theoretical and computational activities are also being undertaken to support the experimental research and to identify interesting new toroidal confinement concepts which could contribute to the understanding of tokamak transport. DOE

N92-24223# International Atomic Energy Agency, Vienna (Austria).
RESEARCH USING SMALL TOKAMAKS
May 1991 198 p Presented at the Technical Committee on Research Using Small Tokamaks, Arlington, VA, 27 Sep. 1990
(DE92-615416; IAEA-TECDOC-604; CONF-9009463) Avail: NTIS HC/MF A09

The technical reports in this document were presented at the IAEA Technical Committee Meeting 'Research on Small Tokamaks', Sep. 1990, in the following sessions: (1) Plasma Modes, Control, and Internal Phenomena; (2) Edge Phenomena; and (3) Advanced Configurations and New Facilities. In Section (1), experiments at controlling low mode number modes, feedback control using external coils, lower-hybrid current drive for the stabilization of sawtooth activity and continuous (1,1) mode, and unmodulated and fast modulated ECRH mode stabilization experiments were reported, as well as the relation to disruptions and transport of low m,n modes and magnetic island growth; static magnetic perturbations by helical windings causing mode locking and sawtooth suppression; island widths and frequency of the m=2 tearing mode; ultra-fast cooling due to pellet injection; and, finally, some papers on advanced diagnostics, i.e., lithium-beam activated charge-exchange spectroscopy, and detection through laser scattering of discrete Alfven waves. In Section (2), experimental edge physics results from a number of machines were presented (positive biasing on HYBTOK II enhancing the radial electric field and improving confinement; lower hybrid current drive on CASTOR improving global particle confinement, good current drive efficiency in HT-6B showing stabilization of sawteeth and Mirnov oscillations), as well as diagnostic developments. Theoretical papers discussed the influence of sheared flow and/or active feedback on edge microstability, large edge electric fields, and two-fluid modelling of non-ambipolar scrape-off layers. Section (3) contained (1) a proposal to construct a spherical tokamak 'Proto-Eta', and (2) an analysis of ultra-low-q and runaway discharges, production, and self-organization of a turbulent plasma. DOE

N92-24224# International Centre for Theoretical Physics, Trieste (Italy).
ANALYTIC SOLUTIONS OF THE TIME-DEPENDENT QUASILINEAR DIFFUSION EQUATION WITH SOURCE AND LOSS TERMS
M. H. A. Hassan and E. A. Hamza Oct. 1991 16 p
(DE92-615435; IC-91/34) Avail: NTIS HC/MF A03

A simplified one-dimensional quasi-linear diffusion equation describing the time evolution of collisionless ions in the presence of ion cyclotron resonance heating (ICRH) and sources and losses is solved analytically for all harmonics of the ion cyclotron frequency. Simple time-dependent distribution functions which are initially Maxwellian and vanish at high energies are obtained and calculated numerically for the first four harmonics of resonance heating. It is found that the strongest ion-tail of the resulting anisotropic distribution function is driven by heating at the second harmonic followed by heating at the fundamental frequency. DOE

N92-24700# Texas Univ., Austin. Inst. for Fusion Studies.
MAGNETIC SURFACES IN A STEADY-STATE TOKAMAK
R. Kinney, T. Tajima, and H. Irie (Nihon Univ., Tokyo, Japan) Feb. 1992 26 p
(Contract DE-FG05-80ET-53088)
(DE92-008589; DOE/ET-53088/535; IFSR-535) Avail: NTIS HC/MF A03

We study a toroidal plasma in a tokamak with externally given toroidal and poloidal magnetic fields as well as self-consistently interacting internal currents. The unperturbed magnetic surfaces are described by the well known nonlinear 'standard map.' When the magnetic field is allowed to carry an internal current, the self-interaction of these currents disturbs the integrity of the magnetic surfaces. We carry out a computational study of the effects of the interacting internal current filaments, measuring the diffusion of field lines from the unperturbed surfaces, and find the self-interaction to be a significant effect which always serves to increase diffusion. Perfect surfaces are difficult to maintain even when magnetic islands do not overlap. Diffusion from the current interaction dominates when current fluctuations reach approx. 10 pct. of the applied field. DOE

N92-24893# National Inst. for Fusion Science, Nagoya (Japan).
PLASMA TRANSPORT SIMULATION MODELING FOR HELICAL CONFINEMENT SYSTEMS
K. Yamazaki and T. Amano Aug. 1991 36 p
(DE92-768117; NIFS-104) Avail: NTIS HC/MF A03

New empirical and theoretical transport models for helical confinement systems are developed based on the neoclassical transport theory including the effect of radial electric field and multi-helicity magnetic components, and the drift wave turbulence transport for electrostatic and electromagnetic modes, or the anomalous semi-empirical transport. These electron thermal diffusivities are compared with CHS (Compact Helical System) experimental data, which indicates that the central transport coefficient of the ECH plasma agrees with the neoclassical axisymmetric value and the transport outside the half radius is anomalous. On the other hand, the transport of NBI-heated plasmas is anomalous in the whole plasma region. This anomaly is not explained by the electrostatic drift wave turbulence models in these flat-density-profile discharges. For the detailed prediction of plasma parameters in a LHD (Large Helical Device), 3-D equilibrium/1-D transport simulations including empirical or drift wave turbulence models are carried out. These transport simulations suggests that the global confinement time of LHD is determined mainly by the electron anomalous transport near the plasma edge region rather than the helical ripple transport in the core region. Even if the ripple loss can be eliminated, the increase of the global confinement is 10 percent. However, the rise in the central ion temperature is more than 20 percent. If the anomalous loss can be reduced to the half level of the present scaling, like so-called 'H-mode' of the tokamak discharge, the neoclassical ripple loss through the ion channel becomes important even in the plasma core. The 5 percent radial inward shift of the plasma column with respect to the major radius is effective for improving plasma confinement and raising more than 50 percent of the fusion product by reducing this neoclassical asymmetric ion transport loss and increasing 10 percent in the plasma radius. DOE

N92-25055# Lawrence Livermore National Lab., CA.
BEAM PLASMA 14 MeV NEUTRON SOURCE FOR FUSION MATERIALS DEVELOPMENT
D. Ravenscroft, D. Bulmer, F. Coensgen, J. Doggett, A. Molvik, P. Souza, L. Summers, and V. Williamson Sep. 1991 6 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract W-7405-eng-48)
(DE92-009003; UCRL-JC-107828; CONF-910968-80) Avail: NTIS HC/MF A02

The conceptual engineering design and expected performance for a 14 MeV DT neutron source is detailed. The source would provide an intense neutron flux for accelerated testing of fusion reactor materials. The 150-keV neutral beams inject energetic deuterium atoms, that ionize, are trapped, then react with a warm (200 eV), dense tritium target plasma. This produces a neutron source strength of 3.6 x 10(exp 17) n/sec for a neutron power density at the plasma edge of 5-10 MW/m(sup 2). This is several times the approximately 2 MW/m(sup 2) anticipated at the first wall of fusion reactors. This high flux provides accelerated end-of-life tests of one- to two-year duration, thus making materials development possible. The modular design of the source and the facilities are described. DOE

N92-25056# Purdue Univ., West Lafayette, IN. School of Nuclear Engineering.
NON-LOCAL KINETIC TRANSPORT STUDIES OF A FIELD-REVERSED CONFIGURATION (FRC)
Chan K. Choi 1991 20 p
(Contract DE-FG02-87ER-53250)
(DE92-010026; DOE/ER-53250/6) Avail: NTIS HC/MF A03

A computer code was developed and tested, during this past period, to determine the global, linear kinetic stability of a one-dimensional field-reversed configuration (FRC). A difficulty in verifying the code for fully electromagnetic perturbations caused the model to be simplified so that it would be easier to verify. The changes in the model were going from a fully electromagnetic field operator to an electrostatic field operator. The resultant simplifications allowed the code to be tested against well-known, analytic results from elementary plasma physics. This report reviews the physical assumptions used to model the plasma and describe the extra assumptions inherent in using an electrostatic model. In addition, the rationale for simplifying the model and the results of the test of the model are presented. DOE

N92-25110# International Centre for Theoretical Physics, Trieste (Italy).
ULTRARELATIVISTIC EFFECTS ON PARAMETRIC INSTABILITIES OF BEAT WAVES IN A TRANSVERSELY MAGNETIZED PLASMA
M. Salimullah and A. A. Mamun (Atomic Energy Research Establishment, Dhaka, Bangladesh) Oct. 1991 6 p
(DE92-619518; IC-91/363) Avail: NTIS HC/MF A02

The possibility of relativistic effects on the parametric instabilities of large amplitude beat waves in a transversely magnetized plasma has been investigated. The relativistic Vlasov equation in gyrokinetic variables has been employed to find the nonlinear response of the plasma electrons. It is noticed that the extreme relativistic consideration does not have any significant effects on the various parametric instabilities of the beat waves in the plasma. DOE

N92-25121# Texas Univ., Austin. Inst. for Fusion Studies.
ON ZERO FREQUENCY MAGNETIC FLUCTUATIONS IN PLASMAS
T. Tajima, S. Cable, and R. M. Kulsrud Jan. 1992 25 p
(Contract DE-FG05-80ET-53088)
(DE92-008590; DOE/ET-53088/533; IFSR-533) Avail: NTIS HC/MF A03

A plasma sustains fluctuations of electromagnetic fields and particle density even in a thermal equilibrium and such fluctuations have a large zero frequency peak. The level of fluctuations in the plasma for a given wavelength and frequency of electromagnetic fields is calculated through the fluctuation-dissipation theorem. The frequency spectrum shows that the energy contained in this peak is complementary to the energy 'lost' by the plasma cutoff effect. The level of the zero (or nearly zero) frequency magnetic is computed as (B sup 2) sup 0/ 8(pi) = 1/2pi sup 3(T)omega sub p/c sup 3, where T and omega sub p are the temperature and plasma frequency. The relation between the nonradiative and radiative fluctuations is elucidated. Both a simple collision model and a kinetic theoretic treatment are presented with essentially the same results. The size of the fluctuations is lambda approx. (c/omega sub p)(eta/omega) sup 1/2, where eta and omega are the collision frequency and the (nearly zero) frequency of magnetic fields oscillations. Perhaps the most dramatic application of the present theory, however, is to the cosmological plasma of early epoch. Implications of these magnetic fields in the early Universe are discussed. Quantum mechanical calculations are also carried out for degenerate plasmas. DOE

N92-24601# Kiel Univ. (Germany, F.R.). Inst. fuer Experimentalphysik.
RESONANCE CONE DIAGNOSTICS OF IONOSPHERIC PLASMA: A REFINED ANALYSIS OF COREX DATA
A. Piel, V. Rohde, H. Thiemann, and K. I. Oyama (Tokyo Univ., Sagamihara, Japan) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 69-74 (For primary document see N92-24589 15-12)
(Contract BMFT-PA4-1OM90010)
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N92-24602# Bergen Univ. (Norway).
COMPARISON OF AURORAL EMISSION AND EISCAT-DERIVED PLASMA PARAMETERS DURING THE FLIGHT OF NEED-2
Finn Soeraas, Kjell Aarsnes, Chris Hall, Asgeir Brekke, Mike Rietveld, and Unni Pia Loevhaug (EISCAT Scientific Association, Ramfjordbotn, Norway) *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 75-81 (For primary document see N92-24589 15-12)
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76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N92-24225# International Centre for Theoretical Physics, Trieste (Italy).
MAGNETO-OPTICAL PHENOMENA IN SEMICONDUCTOR SUPERLATTICES
Hong Shon Nguyen Jul. 1991 10 p
(DE92-615480; IC-91/179) Avail: NTIS HC/MF A02

The Faraday and birefringence effects due to infrared radiation in semiconductor superlattices under a quantized magnetic field are investigated. It is shown that for a non-degenerate electron gas, in the one mini-band approximation, the frequency behavior of magneto-optical coefficients exhibit finite jumps at omega = (eta)omega(sub c) +/- 2(Delta) (omega is the frequency of electromagnetic radiation, omega(sub c) is the cyclotron frequency and Delta is half band width). The natural birefringence and dichroism in superlattices are also calculated. DOE

N92-24226# International Centre for Theoretical Physics, Trieste (Italy).
INSTABILITY OF THE PARAMAGNETIC STATE IN THE KINEMATIC FIELD APPROXIMATION IN THE HUBBARD MODEL
E. G. Goryachev Jul. 1991 5 p
(DE92-615481; IC-91/191) Avail: NTIS HC/MF A01

Within the scope of the approximation of a kinematic field the uniform paramagnetic susceptibility was calculated as (chi)(0,0) = (delta)R(H)/(delta)H when H yields 0 and U yields infinity. It is found that chi(0,0) is less than 0 in the all region, where R=0 (i.e. 0,7 is greater than or approximately n greater than or equal to 0). DOE

N92-24227# International Centre for Theoretical Physics, Trieste (Italy).
THE INFLUENCE OF CONTRACTION IN THE FIRST INTERPLANE DISTANCE ON THE SURFACE STATES OF Ta(001)
R. Baquero and R. deCoss (Instituto Politecnico Nacional, Mexico City.) Aug. 1991 4 p
(DE92-615483; IC-91/242) Avail: NTIS HC/MF A01

We analyze the influence that the recently found Ta(001) first interatomic layer contraction has on the surface electronic structure. We find that the states near the Fermi energy at the gamma point on the 2D First Brillouin zone found in recent experiments are directly related to this contraction. In general, our calculation shows a better agreement with experiment than previous work. The remaining small differences might be attributable to a smaller but non-negligible contraction of the second interatomic layer distance. DOE

N92-24268# Sandia National Labs., Albuquerque, NM.
NEW HIGH(Tc) BENCHMARKS FOR ORGANIC SUPERCONDUTORS BASED ON ET (ELECTRON-DONOR) AND C(SUB 60) (ELECTRON-ACCEPTOR) MOLECULES
J. M. Williams, U. Geiser, K. D. Carlson, H. H. Wang, A. M. Kini, A. J. Schultz, W. K. Kwok, U. Welp, G. W. Crabtree, and M. H. Whangbo 1992 8 p Presented at the 13th Winter Meeting on Low Temperature Physics, Morelos (Mexico), 19-22 Jan. 1992
(Contract DE-AC04-76DP-00789)
(DE92-007525; SAND-92-0204C; CONF-920185-1) Avail: NTIS HC/MF A02

The highest (Tc)'s achieved in organic electron-donor based systems occur in two isostructural ET salts, viz., kappa ((ET)2Cu(N(CN)2))X, X = Br(Tc = 11.6 K, ambient pressure), X = Cl (Tc = 12.8 K, 0.3 kbar) whereas for the electron-acceptor-based systems derived from C-60 they occur in K3C60 (Tc = 19 K), Rb3C60 (Tc = 29 K), Rb(x)Cs(y)C60 (Tc 33 K) and Rb(x)Tl(y)C60 (Tc approx. = 45 K). Research performed at Argonne National Laboratory, and based on the ET and C60 systems, is reviewed. DOE

N92-24286# Brookhaven National Lab., Upton, NY.
MEASUREMENT OF ROCKING CURVE WINGS AT HIGH X RAY ENERGIES
D. Chapman, J. Hastings, H. Moulin, D. P. Siddons, R. F. Garrett, E. Nachaliel, and F. A. Dilmanian 1991 18 p Presented at the 7th National Conference and Exhibition on Synchrotron Radiation Instrumentation, Baton Rouge, LA, 28-31 Oct. 1991
(Contract DE-AC02-76CH-00016)
(DE92-007167; BNL-47048; CONF-9110146-8) Avail: NTIS HC/MF A03

Measurements done recently at the NSLS have indicated that the level of intensity found in the wings of diffraction peaks from silicon at higher x-ray energies (greater than 20 keV) far exceeds the value which would be predicted based on the dynamical theory. We have measured Si (220) double crystal rocking curves at the 40 keV fundamental and harmonics with various crystal scattering geometries: Bragg-Bragg, Laue-Bragg, and Laue-Laue. The comparison of the Bragg and Laue case diffraction geometries was done to determine scattering volume effects. Comparisons with dynamical theory calculations will be discussed. These measurements have been carried out in order to assess the level of harmonic contamination which will be present from a double crystal monochromator being designed for the X17 Superconducting Wiggler Beamline. DOE

N92-24298# Sandia National Labs., Albuquerque, NM.
OPTICAL BLOCH WAVES IN A SEMICONDUCTOR PHOTONIC LATTICE
P. L. Gourley, M. E. Warren, J. R. Wendt, G. A. Vawter, T. M. Brennan, and B. E. Hammons 1991 8 p Presented at the CLEO/QELS 1992, Anaheim, CA, 10-17 May 1992
(Contract DE-AC04-76DP-00789)
(DE92-004214; SAND-91-2711C; CONF-920573-2) Avail: NTIS HC/MF A02

We have characterized optical Bloch waves in a semiconductor photonic lattice comprising periodic cells etched in an epitaxial multi-layer. Stimulated emission from the lattice provides a direct probe of the optical Bloch states. DOE

N92-24549# Lawrence Livermore National Lab., CA.
ANOMALOUS X RAY SCATTERING STUDY OF LOCAL ORDER IN BCC Fe(0.53)Cr(0.47)
L. Reinhard, J. L. Robertson, and S. C. Moss (Houston Univ., TX.) 19 Feb. 1992 16 p Presented at the Joint Metallurgy Society (TMS)-Australasian Institute of Mining and Metallurgy (IMM) Conference, San Diego, CA, 2-5 Mar. 1992
(Contracts W-7405-eng-48; DE-AC05-84OR-21400)
(DE92-009684; UCRL-JC-109905; CONF-920374-2) Avail: NTIS HC/MF A03

The diffuse scattering from a single crystal of Fe(0.53)Cr(0.47) quenched from above the sigma phase boundary, was studied at three X-ray energies. Energy analysis of the scattered beam was used to remove Compton and resonant Raman scattering. The pure static and thermal displacement scattering was determined using a zero contrast technique. The pair interaction energies as obtained from the short-range order parameters fitted to the data compare favorably with electronic structure calculations and the miscibility gap derived from the interactions agrees well with experimental results. The results for static displacements, however, disagree with the conventional treatment of atom size effects in solid solutions. The quench temperature dependence of the decomposition process can not be satisfactorily described within the framework of the kinetic Ising model. DOE

N92-24571# North Carolina Univ., Chapel Hill. Lab. of Chemistry.
SOLID STATE VOLTAMMETRY AND SENSORS IN SOLIDS AND GASES
R. W. Murray Apr. 1992 10 p
(Contract DE-FG05-87ER-13675)
(DE92-007703; DOE/ER-13675/T1) Avail: NTIS HC/MF A02

This project explores the electrochemical reactivity of electron transfer donor/acceptors dissolved in and diffusing through solid and semi-solid, ionically conductive media. The emphasis is on developing voltammetric experiments that are quantitatively interpretable in terms of the mass transport and electron transfer rates and thermodynamic equilibria of the redox solutes, and to exploit such experiments to probe their chemical and electrochemical behavior in the solid media. Techniques for quantitative voltammetry in solids were essentially unknown prior to initiation of this DOE project. We mainly employ poly(ether)s containing dissolved metal salt electrolytes (polymer electrolytes), as prototype solid and semi-solid solvents. During this award year we have: (1) concluded a study of plasticization chemistry in poly(ether) polymer electrolytes; (2) made progress in devising techniques for measuring the rates of electron transfer reactions in solid and semi-solid poly(ether)s; (3) continued efforts to design and understand the behavior of microband electrodes of various widths (0.1 to 10 (mu)m) in voltammetry of redox solutes, and (4) initiated synthetic efforts to attach ethylene oxide chains of various lengths to redox solutes. DOE

N92-24668# Los Alamos National Lab., NM.
INFRARED ABSORPTION SPECTRA OF VARIOUS DOPING STATES IN CUPRATE SUPERCONDUCTORS
K. Yonemitsu, A. R. Bishop, and J. Lorenzana (International School for Advanced Studies, Trieste, Italy) 1992 7 p Presented at the Lattice Effects in High (Tc) Superconductors, Santa Fe, 13-15 Jan. 1992
(Contract W-7405-eng-36)
(DE92-007413; LA-UR-92-342; CONF-920141-1) Avail: NTIS HC/MF A02

Doping states in a two-dimensional three-band extended Peierls-Hubbard model was investigated within inhomogeneous Hartree-Fock and random phase approximation. They are very sensitive to small changes of interaction parameters and their distinct vibrational and optical absorption spectra can be used to identify different doping states. For electronic parameters relevant to cuprate superconductors, as intersite electron-phonon interaction strength increases, the doping state changes from a Zhang-Rice state to a covalent molecular singlet state accompanied by local quenching of the Cu magnetic moment and large local lattice distortion in an otherwise undistorted antiferromagnetic background. In a region where both intersite electron-phonon interaction and on-site electron-electron repulsion are large, we obtain new stable global phases including a bond-order-wave state and a mixed state of spin-Peierls bonds and antiferromagnetic Cu spins, as well as many metastable states. Doping in the bond-order-wave region induces separation of spin and charge. DOE

N92-24675# California Univ., San Diego, La Jolla. Dept. of Electrical and Computer Engineering.
ION MIXING OF SEMICONDUCTOR LAYERED-STRUCTURES
S. S. Lau, J. W. Mayer, and B. Hall (Cornell Univ., Ithaca, NY.)

1992 7 p
(Contract DE-FG03-84ER-45156)
(DE92-008185; DOE/ER-45156/T5) Avail: NTIS HC/MF A02

In the previous period of investigation, we have established the basic ion mixing (IM) characteristics for semiconductor layered structures, in that there is a temperature dependent and a temperature independent regime in ion-mixing of III-V semiconductor systems such as the InGaAs/InP and the AlGaAs/GaAs systems and the Ge/Si system. During the current period of study, we studied parameters that could affect ion-mixing rates in semiconductors. We found that the use of shallow dopants as the mixing ion did not increase the mixing rate, thus indicating that electrically active ions (or the Fermi level) do not play a significant role in ion-mixing. On the other hand, the presence of mismatch strain in Ge/Si layered structures can affect the mixing rate, especially in the temperature independent regime. For the next period of investigation, we plan to concentrate on a more systematic investigation of III-V semiconductor systems. We are particularly interested in reducing the damage caused by ion-mixing and in the use of ions that can induce mixing and raise the electrical resistance in the structure simultaneously. With these issues resolved, we should be in a position to use ion mixing for photonic device fabrication. We intend to fabricate semiconductor superlattice waveguides and modulators. DOE

N92-24702# Lawrence Livermore National Lab., CA.
SIMULATION OF MIXING AT Mo/Si INTERFACES
D. B. Boercker and W. L. Morgan (Kinema Research, Monument, CO.) Dec. 1991 7 p Presented at the Physics of X Ray Multilayer Structures Meeting, Jackson Hole, WY, 2-5 Mar. 1992
(Contract W-7405-eng-48)
(DE92-008921; UCRL-JC-109187; CONF-920397-1) Avail: NTIS HC/MF A02

Soft x-ray projection lithography is a rapidly emerging technology which will have enormous impact on the microelectronics industry, by providing faithful image reduction to a minimum feature size below 1000 Angstroms. X-ray reduction cameras have already been designed and tested, but the successful development of this new technology will depend heavily upon the production of efficient, durable x-ray optics. We have performed molecular dynamics (MD) simulations of the deposition of Mo-on-Si and Si-on-Mo, using interatomic potentials containing three-body terms. These simulations reproduce the experimental asymmetry in the interlayer thickness. When Mo atoms are incident upon a Si substrate they penetrate several layers deep. In contrast, incident Si atoms make virtually no penetrations into the Mo substrates. DOE

N92-24883# Los Alamos National Lab., NM.
APPLICATION OF HIGH PRECISION BAND STRUCTURE CALCULATIONS TO THE EQUATION OF STATE FOR BERYLLIUM OXIDE: SESAME EQUATION OF STATE NUMBER 7612
J. C. Boettger and J. M. Wills Mar. 1992 9 p
(Contract W-7405-eng-36)
(DE92-008202; LA-12250-MS) Avail: NTIS HC/MF A02

High precision electronic band structure calculations for BeO have revealed a large volume discontinuity structural phase transition on the 0 K isotherm at about 1 Mbar. Although this transition was not observed experimentally, the accuracy of the calculations is such that the existence of this transition is unambiguous. A transition of this magnitude is likely to have a substantial impact on hydrodynamic simulations involving BeO. Here we report the creation of a new SESAME equation of state for BeO which incorporates the effect of the theoretically determined phase transition. DOE

N92-24887# Lehigh Univ., Bethlehem, PA.
HIGH RESOLUTION MICROSTRUCTURAL AND MICROCHEMICAL ANALYSIS OF ZIRCONIA EUTECTIC INTERFACES
M. R. Notis 28 Jan. 1992 3 p
(Contract DE-FG02-84ER-45150)
(DE92-008233; DOE/ER-45150/7) Avail: NTIS HC/MF A01

The nature of fine scale microchemical variation in ceramic oxides, in terms of the lattice periodicity, is investigated. During the past year, emphasis was placed on the selection of appropriate materials systems and their fabrication into samples suitable for study using advanced high resolution analytical electron microscopy (work to be performed in the coming year). The work concentrated on two materials systems. DOE

N92-25002 National Physical Lab., Teddington (England). Div. of Electrical Science.
AN INTERCOMPARISON OF MEASUREMENT TECHNIQUES FOR THE DETERMINATION OF THE DIELECTRIC PROPERTIES OF SOLIDS AT NEAR MILLIMETRE WAVELENGTHS
J. R. Birch, G. J. Simonis, M. N. Afsar, R. N. Clarke, J. M. Dutta, H. M. Frost, X. Gerbaux, A. Hadni, W. Hall, and R. Heidinger (Kernforschungszentrum G.m.b.H., Karlsruhe, Germany, F.R.) et al Oct. 1991 291 p
(NPL-DES-115; ISSN-0143-7305; ETN-92-91273) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

Results of a measurement intercomparison aimed at assessing the systematic errors in near millimeter wavelength dielectric measurement on reasonably transparent solid specimens are presented and discussed. Various monochromatic, broad band, guided wave and free space measurement methods are compared in the frequency region from 30 to 900 GHz by round robin comparison of the refractive index and absorption coefficient. Relative permittivity and loss tangent of seven specimens are also considered. Systematic errors of up to 1 are found in refractive index results. Very much larger systematic errors are found in the absorption results. For individual titles, see N92-25003 through N92-25015.

N92-25003 National Physical Lab., Teddington (England).
MEASUREMENTS OF THE COMPLEX REFRACTION SPECTRA OF SOME SELECTED SOLID SPECIMENS
In its An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 54 p (For primary document see N92-25002 15-76)
(Contract DAJA45-83-M-0304)
(NPL-150580; USARDSG-R/D-4427-EE-09) Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

Various measurement techniques that are currently being used for determination of the near millimeter wavelength optical constants of solids are compared. The comparison is achieved by each participating laboratory measuring the optical constants of seven solid specimens over as much of the spectral region between 90 and 600 GHz as their instrumentation allows. The measurement temperature is 293K. An improved understanding of the dominant random and systematic errors in each measurement technique is sought. It is concluded to be difficult to assess all of the systematic errors presented, although in some instances it is possible to identify upper limits for such errors. As these results form only one part of the measurement round robin, these limitations are not considered important. ESA

N92-25004 National Physical Lab., Teddington (England). Div. of Electrical Science.
NPL-2 MEASUREMENT REPORT
R. N. Clarke *In its* An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 3 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

Coherent phase locked klystron sources are used to carry out measurements at 36, 72 and 144 GHz in appropriate specimens. The signals transmitted through the open resonators are detected by means of a heterodyne system having an RF vector network analyzer as a signal stage operating at the 60 MHz system

intermediate frequency. The detection system is designed specifically for measuring very low dielectrics and to this end it employs phase locked millimeter-wave sources to achieve the stability necessary to determine unloaded Q factors of the order of 200,000 and in the range 2000 to 100,00 with a specimen. The full complex transmission coefficient employed for Q factor measurement is under computer control. Two different resonator geometries are employed by two experimenters at 72 GHz. They each employ independent theoretical treatments to derive complex permittivity from the measurements. At 36, 72 and 144 GHz the standard NPL near hemispherical, planconcave resonators are used with the specimen always resting on the plane reflector. Results obtained with this measurement geometry are labelled PR in the table of results. Results in the column headed DFTS are taken from the NPL-1 results and are included for comparison. ESA

N92-25005 Harry Diamond Labs., Adelphi, MD.
FAR INFRARED AND NEAR MILLIMETER WAVE CHARACTERISATION OF SAMPLES IN AN INTERNATIONAL SAMPLE EXCHANGE
G. J. Simonis and M. Stead *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 30 p (For primary document see N92-25002 15-76)
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The instrument used to characterize the materials is a polarizing Fourier transform interferometer operating in free space. Atmospheric effects are not substantial over the operational frequency range (100 to 550 GHz) and the free space path lengths (meters) of these studies. The interferometer is composed of components mounted on an optical table. The source is a 100 W one atmosphere water cooled mercury arc lamp. The source is modulated at 75 Hz with an optical chopper in order to do synchronous detection processing with a lockin amplifier. The use of amplitude modulation rather than phase modulation minimizes the low frequency far infrared rolloff of the instrument function at the low millimeter wave frequencies where the available lamp power is very limited. The wire grating beam splitters also reduce the low frequency rolloff that would otherwise be introduced by the use of mylar beam splitters. A diagrammatic representation of the polarizing interferometer used is presented. ESA

N92-25006 Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.
MIT MEASUREMENT REPORT
M. N. Afsar *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 18 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

Measurements made by transmision dispersive Fourier transform spectroscopy using a polarizing wire grid interferometer in the plane mirror configuration are presented. The radiation source is a mercury vapor arc lamp, the detector a liquid helium cooled indium antimonide hot electron bolometer. The main body of the interferometer was evacuated, but the specimen chamber itself was not, and was isolated from the vacuum environment by a Mylar window. During measurements the specimen chamber was flushed with dry nitrogen gas to remove atmospheric water vapor. The specimen alignment in the sample chamber is defined by being gravity held on a three ball support. Measurements could be made over the spectral range from 0.1 to 4 cm, although all of the present measurements were in the region below 3 cm. The greatest measurement reproducibilities were achieved in the wavenumber region above 0.4 cm. Rapidly decreasing signal levels below 0.4 cm resulted in poorer measurement accuracies in that low wavenumber region. The results of the measurements on the intercomparison specimens are presented in graphs and tables. ESA

N92-25007 North Carolina Central Univ., Durham. Dept. of Physics.
NCCU MEASUREMENT REPORT c35
J. M. Dutta and C. R. Jones *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 4 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

Measurements made at a frequency of 245 GHz using an optically pumped Ci3H3F gas laser are described. The pump radiation was the P32 line of a CO2 electric discharge laser. The refractive index and absorption coefficient of a specimen are found from two distinct measurements using the double beam interferometer shown. A wire mesh beamsplitter transmits a small portion of the output of the laser to a detector which acts as a power monitor. The reflected beam passes through a lens to produce a mildly convergent beam; which is divided into two beams by the Dielectric Prism Coupler (DPC). The transmitted beam from the DPC travels through the mechanical Phase Shifter (PS) before coming to a focus, while the beam reflected from the DPC comes to a focus at the specimen. As the two beams of the interferometer leave the specimen and the phase shifter they enter oversized circular dielectric Wave Guides (WG), which act as low loss transmission lines, coupling the radiation to the mylar Beam Splitter which directs a portion of each to the final detector, a Golay cell. The refractive index of the specimen under study is found by inserting the specimen and adjusting the phase shifter to give an interference null at the final detector. The specimen is then withdrawn, and the phase shifter advanced to return to the next null. ESA

N92-25008 Los Alamos National Lab., NM.
SWEPT-FREQUENCY NEAR MILLIMETER WAVE CHARACTERISATION OF SAMPLES IN AN INTERNATIONAL SAMPLE EXCHANGE c32
H. M. Frost, III and R. S. Vigil *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 2 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

The instrumentation used to characterize the exchange consists of an Automated Scalar Network Analyzer System (ASNAS) operating on the 90 to 100 GHz frequency range coupled to a pseudooptical antenna arrangement for making free space transmission measurements on the samples. The ASNAS involves a computer controlled scalar network analyzer and a swept frequency IMPATT source feeding into a W band waveguide. Two different pairs of W band horn lens antennas (95 GHz center frequency) are employed in the measurements. They were mounted in transmitter receiver configurations. One pair of antennas provides a free space near millimeter wave beam focussed in space at the sample position. The other pair of antennas provides a collimated free space beam incident on the samples. The sample mount is on the same optical track as the antenna mounts. The sample is mounted at an angle and attenuating sheets are inserted before and after the sample to minimize multiple reflection resonance effects between the sample and the antennas. A carbonized foam aperture is used to prevent leakage around the sample and suppress multipath signals. The whole quasioptical apparatus is mounted on a 4 inch thick honeycomb optical table to provide rigidity and vibration isolation. ESA

N92-25009 Nancy Univ. (France). Lab. Infrarouge.
UNIVERSITE DE NANCY (FRANCE) MEASUREMENT REPORT c35
A. Hadni and X. Gerbaux *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 7 p (For primary document see N92-25002 15-76)
Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

Measurements made by conventional Fourier transform spectroscopy using a polarizing wire grid interferometer with roof top reflectors and a rotating polarizing radiation chopper giving 10 Hz radiation modulation are presented. The radiation source used is a mercury vapor arc discharge lamp, and the detector a pumped liquid helium temperature silicon bolometer with a teflon input window and a low temperature quartz wedge acting as a low pass filter. The power transmission spectrum of each specimen measured is determined at nearly normal incidence with the specimen placed in a nominally collimated beam between the final analyzer grid and the output lens. The interferograms are recorded over a range of moving mirror positions about the position of zero path difference. No interferogram weighting function is used in the measurements. The spectral resolution of the measurements is 0.006 cm. ESA

N92-25010 Rockwell International Science Center, Thousand Oaks, CA.

ROCKWELL INTERNATIONAL MEASUREMENT REPORT **c35**

W. Hall and W. Ho *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 4 p (For primary document see N92-25002 15-76)

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The permittivity and loss tangent of the intercomparison specimens are measured at 35 and 100 GHz using a free space transmission and reflection bridge. The specimen under study is placed at a given angle at the focus of a spot forming lens antenna, and its transmission and reflection coefficients measured using two identical receiver horns suitably aligned with respect to the incident beam and the specimen. The relative phase of the transmitted beam can be measured by balancing the phase bridge and tuning for a null-signal with a direct reading phase meter. The dielectric properties are deduced from the observed transmission and reflection coefficients and/or as a function of frequency for a given specimen orientation. ESA

N92-25011 Kernforschungszentrum G.m.b.H., Karlsruhe (Germany, F.R.). Inst. fuer Materialforschung 1.

DIELECTRIC MEASUREMENTS AT 30-40 GHz AND 140 GHz PERFORMED ON THE SPECIMEN SET OF THE NPL INTERCOMPARISON EXERCISE

R. Heidinger and F. Koeniger (Karlsruhe Univ., Germany, F.R.) *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 20 p (For primary document see N92-25002 15-76)

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Ceramic samples (BeO, Macor and quartz) and polymeric samples (Rexolite, polyethylene) are measured for a near millimeter wavelength specimen intercomparison task. The data is used to relate the results of recently established dielectric measuring facilities to results from different techniques. The Ka band (30 to 40 GHz) and D band (140 GHz) are covered by two different Fabry-Perot resonator setups. Data evaluation is discussed in detail and various correction procedures to sample thickness are tested. The results of both frequency bands coincide for most specimens. The lowest dielectric loss is found in single crystal quartz. The dielectric loss increases strongly with frequency in Rexolite only and slightly in Macor. ESA

N92-25012 Osaka Univ., Suita (Japan). Dept. of Applied Physics.

MEASUREMENTS OF THE OPTICAL CONSTANTS OF SOME NEAR-MILLIMETER WAVE MATERIALS BY MEANS OF NON-DISPERSIVE FOURIER TRANSFORM SPECTROSCOPY **c25**

K. Sakai, T. Nakano, Y. Ichioka, and H. Matsuo (Nagoya Univ., Japan) *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 18 p (For primary document see N92-25002 15-76)

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The complex refractive indices of several specimens are measured by means of the nondispersive Fourier transform spectroscopic technique in the region below 1.5 cm. Results are presented for X-cut crystal quartz, Rexolite, Macor, polyethylene, berrylium oxide and Ferroflow. The uncertainties of refractive index and absorption coefficients are estimated for each sample. It is concluded that the method proposed by Loewenstein and Smith using non-dispersive Fourier transform spectroscopy is effective in determining optical constants. ESA

N92-25013 Georgia Tech Research Inst., Atlanta.

GEORGIA INSTITUTE OF TECHNOLOGY FABRY-PEROT MEASUREMENTS **c35**

In National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 14 p (For primary document see N92-25002 15-76)

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The Fabry-Perot cavity and its implementation to carry out Fourier Transform Spectroscopy (FTS) are detailed. Synthesized sources are used to scan frequency from 26 to 100 GHz for recording of data. Measured data for rexolite 1422 and Corning 7940 is presented. Dielectric constant and loss tangent accuracies are restricted to plus or minus 0.005 and 0.0001 respectively. These error bars are dominated by variations observed in the sample thickness. ESA

N92-25014 Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).

INTERNATIONAL COMPARISON MEASUREMENTS AT NEAR MILLIMETRE WAVELENGTHS **c32**

In National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 5 p (For primary document see N92-25002 15-76)

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Measurements carried out on different dielectric samples are described. The input reflection coefficient was measured by illuminating the short circuited sample using a plane Transmission Electron Microscope (TEM) wave generated by a horn lens antenna with an exit diameter of 30 mm and monitoring the standing wave pattern by either a quasioptical four part reflectometer or by an oversized waveguide four port configuration. In the latter case, the horn antenna was connected to the output of the waveguide configuration which implied a crossguide Michelson interferometer consisting of a/2 mm b/ 1 mm oversized waveguide and a mica 45 deg beam splitter. A second beam splitter was used to couple out a part of the generator power to the normalizing port to be free from power fluctuations of the generator. The output power was about 100 mW. In both cases, commercial waveguide X-band thermistor mounts served as power detectors. To determine the five four port parameters of the reflectometers a regression method is applied using the plane copper reflector plate (with removed sample) as the phasable reflection standard. ESA

N92-25015 Physikalisch-Technische Bundesanstalt, Brunswick (Germany, F.R.).

POWER ABSORPTION COEFFICIENT OF REXOLITE IN THE MILLIMETRE AND SUBMILLIMETRE WAVELENGTH REGION **c25**

W. Richter *In* National Physical Lab., An Intercomparison of Measurement Techniques for the Determination of the Dielectric Properties of Solids at Near Millimetre Wavelengths Oct. 1991 4 p (For primary document see N92-25002 15-76)

Copyright Avail: National Physical Lab., Teddington, Middlesex, TW11 0LW, England

A modifified commercial rapid scan Fourier transform spectrometer is used for power absorption measurements. A Digilab

Fourier Transform Spectrometer (FTS)-14 is converted into a polarizing broadband far infrared spectrometer using two wire grids with 25 micrometer spacing and 10 micrometer wire diameter, one as beam splitter in the interferometer and the other as polarizer between source and interferometer. Changes in the optical arrangement were necessary. The experimental setup is shown in diagrammatic form. The usable spectral range extends from 0.6 cm to 9.8 cm. It is limited on both sides by the response of the detector, a germanium bolometer with a quartz cold window, operated at 4.2K. The rexolite specimens of 12.43 and 18.55 mm thickness were placed in the parallel beam directly behind the interferometer. Forty scans with a resolution of 0.05 cm were averaged for one spectrum to improve the signal to noise ratio. Since the difference in the absorption path length is less than the thickness of the thinnest sample, the noise is relatively high in the spectrum and an upper frequency limit of 5 cm could not be exceeded due to the increasing absorption. ESA

N92-25028# Oak Ridge National Lab., TN.
MOLECULAR DYNAMICS SIMULATION OF ELECTRIC FIELD INDUCED MOTION IN CRYSTALLINE POLYETHYLENE
D. W. Noid, B. G. Sumpter, G. L. Liang, and B. Wuderlich 1991 9 p Presented at the ANTEC 1992, Detroit, MI, 3-7 May 1992
(Contract DE-AC05-84OR-21400)
(DE92-004230; CONF-920572-1) Avail: NTIS HC/MF A02

Molecular dynamics simulations are used to study the additional motion in a polymer crystal environment developed by interactions of a dipole with an external static electric field. The internal dynamics reveals that for a sufficiently strong electric field an electric dipole in a polymer chain is reoriented to align along the direction of the applied field. The kinetics of the process is shown to be both temperature- and dipole position-dependent. DOE

N92-25099*# Alabama Univ., Huntsville. Dept. of Chemistry.
GLASS FORMABILITY OF HIGH T(SUB c) Bi-Sr-Ca-Cu-O SUPERCONDUCTORS Final Report
William F. Kaukler 7 May 1992 31 p
(Grant NAG8-152)
(NASA-CR-190309; NAS 1.26:190309) Avail: NTIS HC/MF A03 CSCL 20L

A number of compositions of ceramic oxide high T(sub c) superconductors were evaluated for their glass formation ability by means of rapid thermal analysis during quenching, optical and electron microscopy of the quenched samples, and with subsequent DSC measurements. Correlations between experimental measurements and the methodical composition changes identified the formulations of superconductors that can easily form glass. The superconducting material was first formed as a glass, then with subsequent devitrification it was formed into bulk crystalline superconductor by a series of processing methods. Author

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N92-24257# International Centre for Theoretical Physics, Trieste (Italy).
THE 4-VERTEX THEOREM FOR CONVEX CURVES R(SUP 3)
V. D. Sedykh Sep. 1991 7 p
(DE92-615218; IC-91/273) Avail: NTIS HC/MF A02

It is a well known fact that any smooth closed plane curve with nowhere vanishing curvature has at least four vertices (local extremum points of its curvature). A generalization of this statement for the case of space curves is known as a conjecture of P. Scherk. Here we sketch the proof of this conjecture. DOE

N92-24277# International Centre for Theoretical Physics, Trieste (Italy).
CLASSICAL GRAVITY COUPLED TO LIOUVILLE THEORY
F. D. Mazzitelli and N. Mohammedi Aug. 1991 22 p
(DE92-615238; IC-91/238) Avail: NTIS HC/MF A03

We consider the two dimensional Jackiw-Teitelboim model of gravity. We first couple the model to the Liouville action and c scalar fields and show, treating the combined system as a nonlinear sigma model, that the resulting theory can be interpreted as a critical string moving in a target space of dimension D = c+2. We then analyze the model from a perturbative point of view. We show in particular that the results of conformal field theory are exactly reproduced at the one loop level. We also show that the theory is one loop finite if the cosmological constant Lambda is equal to zero. When Lambda is different from zero the one loop divergences are gauge fixing dependent even on-shell. However, the theory can be renormalized as a nonlinear sigma model if a kinetic term is included for the auxiliary field. DOE

N92-24289# Tennessee Univ., Tullahoma. Space Inst.
APPLICATION OF HIGH TEMPERATURE AIR HEATERS TO ADVANCED POWER GENERATION CYCLES
T. R. Thompson (Tennessee Valley Authority, Chattanooga.), W. H. Boss, and J. N. Chapman 1992 12 p Presented at the 54th Annual American Power Conference, Chicago, IL, 13-15 Apr. 1992
(Contract DE-AC02-79ET-10815)
(DE92-007741; DOE/ET-10815/178; CONF-920432-1) Avail: NTIS HC/MF A03

Recent developments in ceramic composite materials open up the possibility of recuperative air heaters heating air to temperatures well above that feasible with metal tubes. A high temperature air heater (HTAH) has long been recognized as a requirement for the most efficient MHD plants in order to reach high combustor flame temperatures. The application of gas turbines in coal-fired plants of all types has been impeded because of the problems in cleaning exhaust gas sufficiently to avoid damage to the turbine. With the possibility of a HTAH, such plants may become feasible on the basis of air turbine cycles, in which air is compressed and heated in the HTAH before being applied to turbine. The heat exchanger eliminates the need for the hot gas cleanup system. The performance improvement potential of advanced cycles with HTAH application including the air turbine cycle in several variations such as the DOE program on coal-fired air furnace combined cycle variations originated by the authors, and the MHD combined cycle are presented. The status of development of ceramic air heater technology is included. DOE

N92-24563# Florida Univ., Gainesville. Inst. for Fundamental Theory.
THE GRAPH REPRESENTATION APPROACH TO TOPOLOGICAL FIELD THEORY IN 2 + 1 DIMENSIONS
S. P. Martin Feb. 1991 37 p
(Contract DE-FG05-86ER-40272)
(DE92-008768; DOE/ER-40272/123; UFIFT-HEP-91-02) Avail: NTIS HC/MF A03

An alternative definition of topological quantum field theory in 2 + 1 dimensions is discussed. The fundamental objects in this approach are not gauge fields as in the usual approach, but non-local observables associated with graphs. The classical theory of graphs is defined by postulating a simple diagrammatic rule for computing the Poisson bracket of any two graphs. The theory is quantized by exhibiting a quantum deformation of the classical Poisson bracket algebra, which is realized as a commutator algebra on a Hilbert space of states. The wavefunctions in this graph representation approach are functionals on an appropriate set of graphs. This is in contrast to the usual 'connection representation' approach in which the theory is defined in terms of a gauge field and the wavefunctions are functionals on the space of flat spatial connections modulo gauge transformations. DOE

N92-24794*# Utah State Univ., Logan.
THERMION: VERIFICATION OF A THERMIONIC HEAT PIPE IN MICROGRAVITY Final Report, 1990 - 1991
1991 231 p Original contains color illustrations
(Contract NASw-4435)
(NASA-CR-190010; NAS 1.26:190010) Avail: NTIS HC/MF A11; 1 functional color page CSCL 20M

The design and development is examined of a small excore heat pipe thermionic space nuclear reactor power system (SEHPTR). The need was identified for an in-space flight demonstration of a solar powered, thermionic heat pipe element. A demonstration would examine its performance and verify its operation in microgravity. The design of a microsatellite based technology demonstration experiment is proposed to measure the effects of microgravity on the performance of an integrated thermionic heat pipe device in low earth orbit. The specific objectives are to verify the operation of the liquid metal heat pipe and the cesium reservior in the space environment. Two design configurations are described; THERMION-I and THERMION-II. THERMION-I is designed for a long lifetime study of the operations of the thermionic heat pipe element in low earth orbit. Heat input to the element is furnished by a large mirror which collects solar energy and focuses it into a cavity containing the heat pipe device. THERMION-II is a much simpler device which is used for short term operation. This experiment remains attached to the Delta II second stage and uses energy from 500 lb of alkaline batteries to supply heat energy to the heat pipe device. Author

N92-25030# International Centre for Theoretical Physics, Trieste (Italy).
GENERAL PRESCRIPTION FOR UNPHYSICAL AXIAL GAUGE SINGULARITIES
A. I. Alekseev Oct. 1991 6 p
(DE92-619255; IC-91/359) Avail: NTIS HC/MF A02

The generalization of Cauchy principle value prescription is introduced which contains the prescriptions allowing correct definition for the products of the axial gauge singularities and giving no rise to Poincare-Bertrand terms. The gluon self-energy tensor is calculated with account of finite terms for the generalized prescription. DOE

N92-25032# International Centre for Theoretical Physics, Trieste (Italy).
EXPLICIT MINKOWSKI INVARIANCE AND DIFFERENTIAL CALCULUS IN THE QUANTUM SPACE-TIME
Zhan Xu Nov. 1991 14 p
(DE92-619257; IC-91/366) Avail: NTIS HC/MF A03

In terms of the R-circumflex matrix of the quantum group SL(sub q)(2), the explicit Minkowski coordinate commutation relations in the four-dimensional quantum space-time are given, and the invariance of the Minkowski metric is shown. The differential calculus in this quantum space-time is discussed and the corresponding commutation relations are proposed. DOE

N92-25125# International Centre for Theoretical Physics, Trieste (Italy).
GALILEI-ISOTOPIC RELATIVITIES
R. M. Santilli Sep. 1991 13 p
(DE92-619236; IC-91/264) Avail: NTIS HC/MF A03

In this note we further develop the proposal made in preceding works of constructing the infinite family of Lie-isotopic liftings of Galilei's relativity for closed-isolated systems of particles possessing local, potential and selfadjoint, as well as nonlocal, nonhamiltonian and nonselfadjoint internal forces. In particular, we show that the nonlinear and nonlocal generalization of the Galilei transformations introduced in a preceding note do indeed represent motion of extended particles within resistive media, but in such a way to coincide with the conventional transformations at the abstract, realization-free level. This allows the preservation of the basic, physical and mathematical axioms of Galilei's relativity under our liftings, and their realization in the most general possible nonlinear, nonlocal and nonhamiltonian way. DOE

N92-25130# International Centre for Theoretical Physics, Trieste (Italy).
ENERGY-MOMENTUM COMPLEX IN MOELLER'S TETRAD THEORY OF GRAVITATION
F. I. Mikhail, M. I. Wanas, A. Hindawi, and E. I. Lashin (Ain Shams Univ., Cairo, Egypt) Aug. 1991 12 p
(DE92-619250; IC-91/209) Avail: NTIS HC/MF A03

Moeller's tetrad theory of gravitation is examined with regard to the energy-momentum complex. The energy-momentum complex as well as the superpotential associated with Moeller's theory are derived. Moeller's field equations are solved in the case of 'general' spherical symmetry. Two different solutions, giving rise to the same metric, are obtained. The energy associated with one solution is found to be twice the energy associated with the other. An avenue out of this inconsistency is suggested. DOE

N92-25140# International Centre for Theoretical Physics, Trieste (Italy).
A SET OF EXACT TWO SOLITON WAVE SOLUTIONS TO EINSTEIN FIELD EQUATIONS
You-Tang Wang and Zhi-Xian He (Xian Jiaotong Univ., China) Sep. 1991 16 p
(DE92-619251; IC-91/305) Avail: NTIS HC/MF A03

A set of exact solutions of Einstein equations in vacuum is obtained. Taking this set of solutions as seed solutions and making use of the Belinsky-Zakharov generation technique a set of generated solutions is constructed. Both sets of exact solutions and a set of generated solutions describe two solition waves, which propagate in opposite directions and collide with each other, and then recover their original shapes. The singularities of the two sets of solutions are analyzed. The relationship between our solutions and other solutions is also discussed. DOE

N92-25141# International Centre for Theoretical Physics, Trieste (Italy).
INTRODUCTION TO FUNCTIONAL AND PATH INTEGRAL METHODS IN QUANTUM FIELD THEORY
J. Strathdee Nov. 1991 34 p
(DE92-619252; IC-91/309) Avail: NTIS HC/MF A03

The following aspects concerning the use of functional and path integral methods in quantum field theory are discussed: generating functionals and the effective action, perturbation series, Yang-Mills theory and BRST symmetry. DOE

N92-24608# Tromsoe Univ. (Norway). Inst. of Mathematical and Physical Sciences.
CHAOS AS AN ALTERNATIVE ANALYSIS TOOL FOR SOUNDING ROCKET TURBULENCE DATA: AN INTRODUCTION
C. Hall *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 115-120 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N92-24252# General Accounting Office, Washington, DC. National Security and International Affairs Div.
NASA PROCUREMENT: IMPROVING THE MANAGEMENT OF DELEGATED CONTRACT FUNCTIONS. REPORT TO THE CHAIRMAN, SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT, COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY, HOUSE OF REPRESENTATIVES
27 Mar. 1992 25 p
(GAO/NSIAD-92-75; B-246609) Avail: NTIS HC/MF A03; also available from GAO, PO Box 6015, Gaithersburg, MD 20877 HC first copy free, additional copies $2.00

NASA spent over 10 billion dollars during fiscal years 1989-91 on work done by subcontractors. To help ensure that contractors comply with contract requirements, NASA oversees their activities. In many cases, NASA delegates contract oversight activities to another government organization. This report presents the results of the General Accounting Office (GAO) of its assessment of NASA's: (1) compliance with its regulations on the delegation of contract administration functions, (2) communication with Defense Contract Management Command (DCMC) on delegated contract administration functions, and (3) coordination of work performed by DCMC. H.A.

N92-24253# General Accounting Office, Washington, DC.
NASA PROCUREMENT: AGENCYWIDE ACTION NEEDED TO IMPROVE MANAGEMENT OF CONTRACT MODIFICATIONS. REPORT TO THE CHAIRMAN, SUBCOMMITTEE ON INVESTIGATIONS AND OVERSIGHT, COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY, HOUSE OF REPRESENTATIVES
Mar. 1992 23 p
(GAO/NSIAD-92-87; B-244523) Avail: NTIS HC/MF A03

The General Accounting Office (GAO) reports the results of its assessment of the causes and management of cost and schedule modifications of contracts at NASA's four largest procurement centers. Topics covered include: reasons for contract modification, contract administration problems, and enhancing procurement management surveys. H.A.

N92-24901*# National Aeronautics and Space Administration, Washington, DC.
GEORGE M. LOW TROPHY NASA'S QUALITY AND EXCELLENCE AWARD, 1992. APPLICATION GUIDELINES: SMALL BUSINESS
1992 29 p Prepared in cooperation with American Society for Quality Control, Milwaukee, WI
(NASA-TM-107834; NAS 1.15:107834; PB92-160720) Avail: NTIS HC/MF A03 CSCL 05A

Guidelines are given for the selection of small business candidates for the George M. Low Trophy, NASA's Quality and Excellence Award, 1992. Topics covered include candidate eligibility, the selection process milestone schedule, the nomination letter, and the application report. Author

N92-25142*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
SPACE STATION FREEDOM RESTRUCTURE IMPACTS ON TECHNOLOGY EXPERIMENT ACCOMMODATION
Don E. Avery, Lisa D. Collier, David M. DeGrace (Computer Technology Associates, Inc., Hampton, VA.), and Carolyn C. Thomas Feb. 1992 29 p
(NASA-TM-104214; NAS 1.15:104214) Avail: NTIS HC/MF A03 CSCL 05A

This is a follow up to NASA Technical Memorandum (TM) 102766; it provides an overview of the Office of Aeronautics and Space Technology (OAST) Space Station Freedom (SSF) Technology Development Payload Program, reviews the OAST SSF resource requirements, and contrasts the requirements with the resources that are available to OAST since the restructure of SSF. A discussion of the issues as well as conclusions and recommendations, is provided. It is concluded that, even after adjustments to the OAST traffic model to reflect restructure, some resources will be inadequate even at the 20 percent allocation level. It is also concluded that bartering resources among U.S. users and international partners, and increasing the level of automation may be viable solutions to the resource constraint problem. The final conclusion is that, to facilitate the performance of technology experiments on SSF, OAST should fund SSF experiments and update its traffic model as soon as possible, and should provide technical and programmatic assistance to technology experiment developers. Author

N92-24396# Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn (Germany, F.R.).
DARA: THE GERMAN SPACE AGENCY [DARA: DIE DEUTSCHE AGENTUR FUER RAUMFAHRTANGELEGENHEITEN GMBH]
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 117-119 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N92-24212# Pacific Northwest Lab., Richland, WA.
THE GEOGRAPHIC INFORMATION SYSTEM COMPONENT OF THE HANFORD ENVIRONMENTAL INFORMATION SYSTEM
S. Tzemos and E. S. Overton Jan. 1992 36 p
(Contract DE-AC06-76RL-01830)
(DE92-007604; PNL-7832) Avail: NTIS HC/MF A03

The Hanford Environmental Information System (HEIS) was developed to manage the data from the characterization and environmental monitoring of the Hanford Site. HEISGIS is the Geographic Information Systems component of HEIS. This report analyzes the HEISGIS functional requirements as articulated by the members of a GIS subcommittee established by the HEIS Technical Advisory Committee (HTAC) in a series of meetings. These functionalities are identified throughout this report, but no implementation commitment is made. This requirements analysis document will be followed by a brief list of the functionalities that will be implemented in FY91 and a description of the requisite acceptance test criteria. DOE

N92-24348# RAND Corp., Santa Monica, CA.
ARTIFICIAL SOCIETIES: A CONCEPT FOR BASIC RESEARCH ON THE SOCIETAL IMPACTS OF INFORMATION TECHNOLOGY
Carl H. Builder and Steven C. Bankes Jul. 1991 27 p
(RAND-P-7740) Avail: NTIS HC/MF A03

The authors argue that the most important policymaking over the next several decades will occur at the intersections of the information technologies and social change. Policies to control and exploit the effects of the information technologies upon societies will be highly sought; but the understanding of those effects upon different cultures and social structures will probably be less than necessary or desired for sound policymaking. The authors propose a long term scheme for basic research into the effects of information technology upon different societies created in a computer laboratory. The study of such artificial societies under different information overlays could provide the basis for

theory development and a body of research to inform policymaking in the future. Author

N92-24791*# NASA Scientific and Technical Information Facility, Baltimore-Washington International Airport, MD.
DIGITAL IMAGING TECHNOLOGY ASSESSMENT: DIGITAL DOCUMENT STORAGE PROJECT
7 Aug. 1989 214 p Sponsored by NASA, Washington
(NASA-CR-189794; NAS 1.26:189794) Avail: NTIS HC/MF A10 CSCL 05B

An ongoing technical assessment and requirements definition project is examining the potential role of digital imaging technology at NASA's STI facility. The focus is on the basic components of imaging technology in today's marketplace as well as the components anticipated in the near future. Presented is a requirement specification for a prototype project, an initial examination of current image processing at the STI facility, and an initial summary of image processing projects at other sites. Operational imaging systems incorporate scanners, optical storage, high resolution monitors, processing nodes, magnetic storage, jukeboxes, specialized boards, optical character recognition gear, pixel addressable printers, communications, and complex software processes. Author

N92-24847# Department of Agriculture, Washington, DC. Agricultural Cooperative Service.
INFORMATION SYSTEM ADOPTION AND USE IN LOCAL COOPERATIVES
R. P. King and I. G. Shuker Jun. 1991 17 p
(PB92-128545; ACS/RR-98) Avail: NTIS HC/MF A03 CSCL 05B

Advances in information technology can help local cooperatives remain competitive in a changing agricultural sector. The adaption and use is examined of information systems by local farm supply cooperatives and grain cooperatives and the relationships between information system characteristics and cooperative performance. Cooperative characteristics were found to have a significant effect on information selection, overall cost structure, and the allocation of information performance. Information system selection was also related to operating performance. Author

N92-24970# Grenoble-1 Univ. (France). Lab. de Genie Informatique.
CONTROL OF THE COHERENCE IN OBJECT DATABASES: A BEHAVIORAL APPROACH Ph.D. Thesis [CONTROLE DE LA COHERENCE DANS LA BASES OBJETS: UNE APPROCHE PAR LE COMPORTEMENT]
Herve Martin 1991 171 p In FRENCH
(ETN-92-91316) Avail: NTIS HC/MF A08

The control of the coherence in object oriented data bases is discussed. The fact that object oriented data bases can be modeled in the same data and processing concept is used. A model of stresses, based on the behavior of the objects and modeled by the methods, is proposed. Instead of restraining the state of the objects, the behavior is restrained. The following assumptions were considered: when the behavior of the object is either coherent or incoherent during the transaction, the transaction gives a data base which is respectively coherent and incoherent. This definition of incorence is very strong and must be softened. First of all, certain behaviors can not be judged locally, but globally. Moreover, the coherence must accept exceptions to the general rules. As a consequence, certain behaviors must be considered as incoherent. They must be analyzed as a function of the context, and then the decision for classifying them, at the end of the transaction as being normal or incoherent can be performed. ESA

N92-25035# Oak Ridge National Lab., TN.
ALPHA MIS: REFERENCE MANUAL
J. K. Lovin, R. L. Haese, R. D. Heatherly, S. E. Hughes, J. S. Ishee, S. M. Pratt, and D. W. Smith Feb. 1992 103 p
(Contract DE-AC05-84OR-21400)
(DE92-009663; ORNL/TM-8621/R2) Avail: NTIS HC/MF A06

ALPHA is a powerful and versatile management information system (MIS) initiated and sponsored by the Finance and Business Management Division of Oak Ridge National Laboratory, who maintain and develop it in concert with the Business Systems Division for its information center. A general-purpose MIS, ALPHA allows users to access System 1022 and System 1032 databases to obtain and manage information. From a personal computer or a data terminal, Energy Systems employees can use ALPHA to control their own report reprocessing. Using four general commands (Database, Select, Sort, and Report) they can: (1) choose a mainframe database; (2) define subsets within it; (3) sequentially order a subset by one or more variables; and (4) generate a report with their own or a canned format. DOE

N92-25066# Oak Ridge Y-12 Plant, TN.
IMPLEMENTING AN INFORMATION ENGINEERING ENVIRONMENT
P. C. Jones Mar. 1991 9 p
(Contract DE-AC05-84OS-21400)
(DE92-008033; Y/CSD/INF-91/20) Avail: NTIS HC/MF A02

Information engineering is an emerging discipline which addresses system and software development. It offers many recognized improvements in both the quality and productivity of the application development process. However, the implementation of information engineering in an existing application development environment is often difficult. This is due to the changes required in the process, the techniques utilized in the process, and the introduction of computer aided system engineering (CASE) tools. Issues in these three areas which will arise during the implementation process are discussed, as well as implementation strategies which have been developed to address them. Specific mechanisms for managing the inevitable changes are also identified. Information engineering and CASE are strategic technologies which should be considered in the context of other strategic initiatives in the development environment. DOE

N92-24398*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.
THE NASA-IGES GEOMETRY DATA EXCHANGE STANDARD
Matthew W. Blake, Jin J. Chou, Patricia A. Kerr, and Scott A. Thorp (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) *In* NASA. Langley Research Center, Software Surface Modeling and Grid Generation Steering Committee Apr. 1992 p 1-6 (For primary document see N92-24397 15-61)
(Contract NAS2-12961)
Avail: NTIS HC/MF A22 CSCL 05B

N92-24789# European Space Agency. European Space Operations Center, Darmstadt (Germany, F.R.).
PROCESSING QUICK-LOOK LASER DATA FROM ERS-1
P. Duque, John M. Dow, M. M. RomayMerino, and T. MartinMur (Grupo de Mecanica del Vuelo S.A., Madrid, Spain) *In its* Spacecraft Flight Dynamics Dec. 1991 p 515-519 (For primary document see N92-24719 15-12)
Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N92-24271# Oak Ridge Associated Universities, Inc., TN.
ASSESSMENT OF MATHQUEST, SUMMER 1991
K. Lopez, L. Blair, S. Clark, J. LoConte, and L. Smalley Dec. 1991 13 p
(Contract DE-AC05-76OR-00033)
(DE92-008412; DOE/OR-00033/T472) Avail: NTIS HC/MF A03

This report provides descriptive information and an assessment of MathQuest 1991, a summer math camp sponsored by the U.S. Department of Energy and conducted by Oak Ridge Associated Universities. The MathQuest program was designed to enhance middle school students' interest in mathematics and their

appreciation of the usefulness of mathematics in life and work. Descriptive information is provided for both the 68 student participants and the math camp activities. The participants were diverse in their abilities and academic experiences in mathematics and other coursework (the majority were 'B' and 'C' students in math). The participants were almost evenly split between males and females and had a racial/ethnic distribution similar to the total population of East Tennessee. DOE

N92-24355# Cologne Univ. (Germany, F.R.). Lehrstuhl fuer Wirtschaftsinformatik.
ECONOMICAL ASPECTS OF SATELLITE APPLICATION SYSTEMS FOR COMMERCIAL COMMUNICATION [WIRTSCHAFTLICHKEITSASPEKTE VON SATELLITENANSWENDUNGSSYSTEMEN IN DER GESCHAEFTLICHEN KOMMUNIKATION]
D. Seibt *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 23 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N92-24346# RAND Corp., Santa Monica, CA. Project Air Force.
IMPROVING THE USAF TECHNOLOGY TRANSFER PROCESS
William C. Martel, Donald Putnam Henry, and C. R. Neu 1991 29 p
(Contract F49620-86-C-0008)
(RAND-R-4081-AF; ISBN-8-8330-1152-9; LC-91-18364) Avail: NTIS HC/MF A03

This report examines the range of issues that were briefed to the Security Assistance Management Improvements Working Group in the U.S. Air Force. It outlines research on the technological transfer process, provides some observations on the coordination process and the role of the Air Force in technology transfer cases, identifies several problems, and concludes with several proposals for solving them. H.A.

88 SPACE SCIENCES (GENERAL)

N92-24889*# Congress of the United States, Washington, DC.
NASA'S OFFICE OF SPACE SCIENCE AND APPLICATIONS: PROCESS, PRIORITIES, AND GOALS
Jan. 1992 35 p
(NASA-CR-189879; NAS 1.26:189879; PB92-152503) Avail: NTIS HC/MF A03 CSCL 05A

Summarized here are the activities of a one-day workshop convened to assess the effectiveness and priority setting mechanisms used by NASA's Office of Space Science and Applications in carrying out its diverse scientific programs. Among the topics discussed were strategic planning, decision making, and goal setting. Author

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N92-24975*# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
REANALYSIS OF X RAY EMISSION FROM M87 II: MULTIPHASE MODELS
John C. Tsai and Edmund Bertschinger 1992 40 p
(Grant NAG5-1355)
(NASA-CR-190220; NAS 1.26:190220) Avail: NTIS HC/MF A03 CSCL 03A

In a previous paper by the authors (hereafter TB), it was shown that the hot intracluster gas around M87 could not be adequately explained in terms of a spherically symmetric, single phase model. It was found that although data from the Einstein satellite High Resolution Imager (HRI), Imaging Proportional Counter (IPC), and Focal Point Crystal Spectrometer (FPCS) could indeed be simultaneously explained by a single phase model, data from the Solid State Spectrometer (SSS) and optically determined mass estimates could not be similarly explained. A qualitative discussion was then given to indicate how the adoption of a specific multiphase model could plausibly improve upon the single phase model, but a detailed discussion was delayed until now. The x ray data is reanalyzed for the gas around M87 in the same spirit as the work in TB. That is, by assuming several cooling flow models, the shortcomings are improved upon. The procedure of TB was adopted and the data reanalyzed in the following manner: a multiphase model is assumed which can compute the surface brightness as seen by HRI and IPC. Also, the line fluxes can be computed of the lines seen by the FPCS and the mass profile after assuming hydrostatic equilibrium. The parameters of the model are then adjusted to fit the data. A check is then made to see whether the resulting model is consistent with the SSS spectrum and the equivalent width of the 7 keV complex of Fe lines as seen by large field of view instruments. Author

N92-24308*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Communications Systems Research Section.
ALIGNMENT OF THE ATMOSPHERIC VISIBILITY MONITORING TELESCOPE
K. Cowles and D. Erickson *In its* The Telecommunications and Data Acquisition Report 15 Feb. 1992 p 79-83 (For primary document see N92-24301 15-32)
Avail: NTIS HC/MF A14; 13 functional color pages CSCL 03A

N92-24362# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
INVESTIGATION OF THE APPLICATION OF SIS ELEMENTS IN THE SUBMILLIMETER RANGE (ABOVE 300 GHz), AND DEVELOPMENT OF THE TECHNOLOGY FOR HIGH SENSITIVITY RECEIVERS WITH A VIEW TO THE MISSION FIRST [UNTERSUCHUNG ZUR ANWENDUNG VON SIS-ELEMENTEN IM SUBMILLIMETERBEREICH (GREATER THAN 300 GHZ) UND ENTWICKLUNG DER TECHNOLOGIE HOCHEMPFINDLICHER EMPFAENGER IM HINBLICK AUF DIE FIRST MISSION]
P. G. Metzger *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 39-40 In GERMAN (For primary

document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24390# Ruhr Univ., Bochum (Germany, F.R.). Astronomisches Inst.
THE HEXA-POD TELESCOPE WITH DIGITAL IMAGE PROCESSING: SUPERTELESCOPE REQUIRES NEW IDEAS [HEXA-POD-TELESKOP MIT DIGITALER BILDVERARBEITUNG: SUPERTELESKOP ERFORDERT NEUE IDEEN]
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 101-102 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24651# Geneva Observatory (Switzerland).
NEW POINTING TECHNIQUES FOR BALLOON BORNE TELESCOPES Abstract Only
D. Huguenin *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 355 (For primary document see N92-24589 15-12)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24750*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE IN-FLIGHT CALIBRATION OF THE HUBBLE SPACE TELESCOPE FINE GUIDANCE SENSORS
G. L. Welter, L. Abramowicz-Reed, Aloke K. Guha, L. Hallock, and E. Kimmer (Allied-Signal Corp., Kansas City, MO.) *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 239-244 (For primary document see N92-24719 15-12)
(Contract NAS5-31500)
Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders CSCL 03A

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N92-24228*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
THE AE-8 TRAPPED ELECTRON MODEL ENVIRONMENT
James I. Vette Nov. 1991 131 p
(NASA-TM-107820; NAS 1.15:107820; NSSDC/WDC-A-RS-91-24)
Avail: NTIS HC/MF A07 CSCL 03B

The machine sensible version of the AE-8 electron model environment was completed in December 1983. It has been sent to users on the model environment distribution list and is made available to new users by the National Space Science Data Center (NSSDC). AE-8 is the last in a series of terrestrial trapped radiation models that includes eight proton and eight electron versions. With the exception of AE-8, all these models were documented in formal reports as well as being available in a machine sensible form. The purpose of this report is to complete the documentation, finally, for AE-8 so that users can understand its construction and see the comparison of the model with the new data used, as well as with the AE-4 model. Author

N92-24255# Los Alamos National Lab., NM.
THE IMPORTANCE OF RADIATIVE TRANSFER IN STELLAR PULSATION MODELS
C. G. Davis 1992 4 p Presented at the International Astronomical Union Meeting, Mito (Japan), 6-10 Jan. 1992
(Contract W-7405-eng-36)
(DE92-007566; LA-UR-92-308; CONF-920184-1) Avail: NTIS HC/MF A01

With the advent of the new astrophysical opacities it seems appropriate to discuss the need for a full radiative transfer (RT) theory instead of the usual equilibrium diffusion theory used in most nonlinear pulsation codes. Early studies on the importance of RT in the calculation of light curves for Cepheid models showed little effect over diffusion theory. The new opacities though may help to explain the 'bump' mass discrepancy problem. For RR Lyrae models the use of RT theory causes some effects both in the color differences (U-B) as well as the light curves. New opacities help to explain the period ratios for double mode RR Lyrae and beat Cepheids. A new area of research is in the modeling of stars with high luminosity to mass ratios that show tendencies for doubling and transitions to chaos, such as W Virginis and RV Tauri stars. For these stars it has been shown the RT is necessary in calculating their light curves and that the understanding of the shock dynamics depends on the transfer of lines in the pulsating RT dependent atmospheres. DOE

N92-24260# International Centre for Theoretical Physics, Trieste (Italy).
GALAXIES AND STARS: BASIC BUILDING BLOCKS OF THE UNIVERSE
Yao-Quan Chu Jul. 1991 13 p
(DE92-615229; IC-91/194) Avail: NTIS HC/MF A03

Recently there has been a rapid progress in our knowledge of the nature of the universe. Particularly, many new observational results show a strong challenge to the standard model of the universe. A selection of representative studies are reviewed, including the large scale distribution of dark matter and quasar-stellar objects (QSOs); the associations of low redshift galaxies with high redshift QSOs; the periodicity distribution of redshifts et. al. DOE

N92-24264# International Centre for Theoretical Physics, Trieste (Italy).
A GENERAL RELATIVISTIC HYDROSTATIC MODEL FOR A GALAXY
R. Hojman, L. Pena, and N. Zamorano (Chile Univ., Santiago.) Aug. 1991 35 p
(DE92-615233; IC-91/244) Avail: NTIS HC/MF A03

The existence of huge amounts of mass laying at the center of some galaxies has been inferred by data gathered at different wavelengths. It seems reasonable then, to incorporate general relativity in the study of these objects. A general relativistic hydrostatic model for a galaxy is studied. We assume that the galaxy is dominated by the dark mass except at the nucleus, where the luminous matter prevails. It considers four different concentric spherically symmetric regions, properly matched and with a specific equation of state for each of them. It yields a slowly raising orbital velocity for a test particle moving in the background gravitational field of the dark matter region. In this sense we think of this model as representing a spiral galaxy. The dependence of the mass on the radius in cluster and field spiral galaxies published recently, can be used to fix the size of the inner luminous core. A vanishing pressure at the edge of the galaxy and the assumption of hydrostatic equilibrium everywhere generates a jump in the density and the orbital velocity at the shell enclosing the galaxy. This is a prediction of this model. The ratio between the size core and the shells introduced here are proportional to their densities. In this sense the model is scale invariant. It can be used to reproduce a galaxy or the central region of a galaxy. We have also compared our results with those obtained with the Newtonian isothermal sphere. The luminosity is not included in our model as an extra variable in the determination of the orbital velocity. DOE

N92-24555# Iowa State Univ. of Science and Technology, Ames.
VERY HIGH ENERGY GAMMA RAY ASTROPHYSICS
R. C. Lamb and D. A. Lewis 1 Feb. 1992 15 p
(Contract DE-FG02-91ER-40634)
(DE92-007731; DOE/ER-40634/1) Avail: NTIS HC/MF A03

The second reflector (project GRANITE) is on schedule. At present (January 1992) it and the 10 m reflector are obtaining stereoscopic views of gamma-ray air showers from the Crab Nebula

which verify the expected performance of the twin reflector telescopes. With the additional improvements of the upgrade (a pending DOE proposal) the twin reflectors should reach a limiting intensity of 1 percent of that of the Crab. The astonishing early results from the EGRET detector aboard the Compton Gamma Ray Observatory indicate that distant quasars (powered by supermassive black holes) are active at GeV energies. The Whipple instruments are poised to see if such behavior continues above 100 GeV, as well as perform sensitive observations of previously reported GeV (Geminga) and TeV (Hercules X-1, etc.) sources. In addition to observing sources and identifying their location in the sky to one arcminute, experiments are planned to search for WIMPS in the mass range 0.1 to 1 TeV, and to determine the abundance of anti-protons in the cosmic rays. The successful performance of the stereoscopic reflectors demonstrates the feasibility of the concept of arrays of Cherenkov receivers. Design studies for a much larger array (CASITA) are just beginning. DOE

N92-24561# Florida Univ., Gainesville. Inst. for Fundamental Theory.

PHASE-SPACE STRUCTURE OF COLD DARK MATTER HALOS

P. Sikivie and J. R. Ipser 1991 12 p
(Contract DE-FG05-86ER-40272)
(DE92-008766; DOE/ER-40272/135; UFIFT-HET-91-17) Avail: NTIS HC/MF A03

A galactic halo of cold dark matter particles has a sheet-like structure in phase-space. The energy and momentum spectra of such particles on earth has a set of peaks whose central values and intensities form a record of the formation of the Galaxy. Scattering of the dark matter particles by stars and globular clusters broadens the peaks but does not erase them entirely. The giant shells around some elliptical galaxies may be a manifestation of this structure. DOE

N92-24716*# California Inst. of Tech., Pasadena. Space Radiation Lab.

RESEARCH IN COSMIC AND GAMMA RAY ASTROPHYSICS Final Report, 1 Oct. 1969 - 30 Mar. 1990

Edward C. Stone, Richard A. Mewaldt, and Thomas A. Prince 13 Mar. 1992 45 p
(Grant NGR-05-002-160)
(NASA-CR-190083; NAS 1.26:190083) Avail: NTIS HC/MF A03 CSCL 03B

Discussed here is research in cosmic ray and gamma ray astrophysics at the Space Radiation Laboratory (SRL) of the California Institute of Technology. The primary activities discussed involve the development of new instrumentation and techniques for future space flight. In many cases these instrumentation developments were tested in balloon flight instruments designed to conduct new investigations in cosmic ray and gamma ray astrophysics. The results of these investigations are briefly summarized. Specific topics include a quantitative investigation of the solar modulation of cosmic ray protons and helium nuclei, a study of cosmic ray positron and electron spectra in interplanetary and interstellar space, the solar modulation of cosmic rays, an investigation of techniques for the measurement and interpretation of cosmic ray isotopic abundances, and a balloon measurement of the isotopic composition of galactic cosmic ray boron, carbon, and nitrogen. Author

N92-25116# Los Alamos National Lab., NM.

CAPTURING ASTEROIDS INTO BOUND ORBITS AROUND THE EARTH: MASSIVE EARLY RETURN ON AN ASTEROID TERMINAL DEFENSE SYSTEM

J. G. Hills Feb. 1992 8 p Presented at the ECA Intercept Conference, Los Alamos, NM, 14-16 Jan. 1992
(Contract W-7405-eng-36)
(DE92-008450; LA-UR-92-466; CONF-920191-1) Avail: NTIS HC/MF A02

Nuclear explosives may be used to capture small asteroids (e.g., 20 to 50 meters in diameter) into bound orbits around the earth. The captured objects could be used for construction material for manned and unmanned activity in Earth orbit. Asteroids with small approach velocities, which are the ones most likely to have close approaches to the Earth, require the least energy for capture. They are particularly easy to capture if they pass within one Earth radius of the surface of the Earth. They could be intercepted with intercontinental missiles if the latter were retrofit with a more flexible guiding and homing capability. This asteroid capture-defense system could be implemented in a few years at low cost by using decommissioned ICMs. The economic value of even one captured asteroid is many times the initial investment. The asteroid capture system would be an essential part of the learning curve for dealing with larger asteroids that can hit the earth. DOE

N92-24358# Sternwarte Bonn (Germany, F.R.).

ASTROMETRY FOR HIPPARCOS: PREPARATORY AND ACCOMPANYING GROUND-BASED CONTRIBUTIONS TO THE 1ST EMISSION OF THE ASTROMETRY SATELLITE [ASTROMETRIE FUER HIPPARCOS. VORBEREITENDE UND BEGLEITENDE ERDGEBUNDENE BEITRAEGE ZUR MISSION DES ERSTEN ASTROMETRIE-SATELLITEN]

In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 31-32 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24359# Sternwarte Bonn (Germany, F.R.).

STUDY OF THE KINEMATICS OF GASES IN THE MILKY WAY [UNTERSUCHUNG DER KINEMATIK DER GASE DER MILCHSTRASSE]

K. S. deBoer *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 33-34 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24360# Muenster Univ. (Germany, F.R.). Inst. fuer Astronomie.

PARTICIPATION OF THE MUENSTER UNIVERSITY INSTITUTE OF ASTRONOMY (AIM) IN SPACE PROJECTS [TEILNAHME DES ASTRONOMISCHEN INSTITUTS DER UNIVERSITAET MUENSTER (AIM) AN RAUMFAHRPROJEKTEN]

In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 35-36 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24361# Cologne Univ. (Germany, F.R.). Inst. fuer Physik.

PHYSICS AND CHEMISTRY OF INTERSTELLAR CLOUDS: KOELNER OBSERVATORY FOR SUBMILLIMETER ASTRONOMY (KOSMA) [DIE PHYSIK UND CHEMIE INTERSTELLARER WOLKEN: KOELNER OBSERVATORIUM FUER SUBMILLIMETER-ASTRONOMIE-KOSMA]

G. Winnewisser, R. Schieder, and J. Stutzki *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 37-38 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24365# Bonn Univ. (Germany, F.R.). Inst. fuer Astrophysik und Extraterrestrische Forschung.
INSTITUTE OF ASTROPHYSICS AND EXTRATERRESTRIAL RESEARCH OF THE RHINELAND FRIEDRICH-WILHELM BONN UNIVERSITY (GERMANY, F.R.): RESEARCH FIELD OF INTERPLANETARY SPACE AND SOLAR WIND [DAS INSTITUT FUER ASTROPHYSIK UND EXTRATERRESTRISCHE FORSCHUNGDER RHEINISCHEN FRIEDRICH-WILHELMS UNIVERSITAET]
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 47-48 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24366# Bonn Univ. (Germany, F.R.). Inst. fuer Astrophysik und Extraterrestrische Forschung.
AERONOMIC STUDIES WITH THE SAN MARCO D/ITG: ODA AND ASSI [AERONOMIE MIT SAN MARCO D/ITG: ODA UND ASSI]
M. Roemer *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 49-52 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24367# Gesamthochschule, Wuppertal (Germany, F.R.). Fachbereich Naturwissenschaften.
SISSI: SPECTROSCOPIC INFRARED STRUCTURE SIGNATURES INVESTIGATION [SISSI: SPECTROSCOPIC INFRARED STRUCTURE SIGNATURES INVESTIGATION]
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation in Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 53-54 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24368# Cologne Univ. (Germany, F.R.). Abt. Weltraumphysik.
MAGNETIC FIELD EXPERIMENT OF THE CLUSTER MISSION: INVESTIGATIONS OF SPATIAL STRUCTURES IN THE EARTH MAGNETOSPHERE [MAGNETFELDEXPERIMENT DER CLUSTER-MISSION: UNTERSUCHUNGEN VON RAEUMLICHEN STRUKTUREN IN DER MAGNETOSPHAERE DER ERDE]
R. V. Stein *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 55-56 In GERMAN Sponsored by Bundesministerium fuer Forschung und Technologie (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24369# Cologne Univ. (Germany, F.R.). Abt. Weltraumphysik.
MAGNETIC FIELD EXPERIMENTS OF THE TSS-1 MISSION: INVESTIGATIONS OF THE ELECTRODYNAMICS OF A TETHERED SATELLITE [MAGNETFELDEXPERIMENTE DER TSS-1-MISSION: UNTERSUCHUNGEN ZUR ELEKTRODYNAMIK EINES SEILGEFESSELTEN SATELLITENSYSTEMS]
A. Luettgen and H. Marschall *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 57-58 In GERMAN Sponsored by Bundesministerium fuer Forschung und Technologie (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24370# Cologne Univ. (Germany, F.R.). Abt. Weltraumphysik.
MAGNETOMETER EXPERIMENT OF THE ESA MISSION GIOTTO: TECHNICAL REALIZATION, DATA EVALUATION AND INTERPRETATION OF THE MAGNETIC FIELD DATA OF THE PASSING FLIGHT OF HALLEY'S COMET [MAGNETOMETEREXPERIMENT DER ESA-MISSION GIOTTO: TECHNISCHE DURCHFUEHRUNG, DATENAUSWERTUNG UND -INTERPRETATION DER MAGNETFELDDATEN DES VORBEIFLUGS AM KOMETEN HALLEY]
K.-H. Glassmeier and J. Raeder *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 59-60 In GERMAN Sponsored by Bundesministerium fuer Forschung und Technologie (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24647# Max-Planck-Inst. fuer Aeronomie, Katlenburg-Lindau (Germany, F.R.).
F-CORONA-EXPERIMENT: REQUIREMENTS FOR REMOTE SENSING OF INTERPLANETARY DUST
Ingrid Mann and Hermann Hartwig *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 335-337 (For primary document see N92-24589 15-12)
(Contracts BMFT-01-OS-89023; BMFT-50-ON-9101)
Copyright Avail: NTIS HC/MF A18; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

N92-24725# Universidad Politecnica de Barcelona (Spain). Departament de Matematica Aplicada y Analisi.
A QUASIPERIODIC SOLUTION AS A SUBSTITUTE OF L4 IN THE EARTH-MOON SYSTEM
Gerard Gomez, Angel Jorba, Josep Masdemont (Universidad Politecnica de Catalunya, Spain), and C. Simo *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 35-41 (For primary document see N92-24719 15-12)
Copyright Avail: NTIS HC/MF A25; ESA, EPD, ESTEC, Noordwijk, Netherlands, HC 90 Dutch guilders

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N92-24682*# Georgia Inst. of Tech., Atlanta. School of Earth and Atmospheric Sciences.
ADDITIONS TO MARS GLOBAL REFERENCE ATMOSPHERIC MODEL (MARS-GRAM) Final Technical Report, 29 Apr. 1991 - 28 Apr. 1992
C. G. Justus and Bonnie James Apr. 1992 35 p
(Grant NAG8-877; GIT Proj. G-35-675)
(NASA-CR-190213; NAS 1.26:190213) Avail: NTIS HC/MF A03 CSCL 03B

Three major additions or modifications were made to the Mars Global Reference Atmospheric Model (Mars-GRAM): (1) in addition to the interactive version, a new batch version is available, which uses NAMELIST input, and is completely modular, so that the main driver program can easily be replaced by any calling program, such as a trajectory simulation program; (2) both the interactive and batch versions now have an option for treating local-scale dust storm effects, rather than just the global-scale dust storms in the original Mars-GRAM; and (3) the Zurek wave perturbation model was added, to simulate the effects of tidal perturbations, in addition to the random (mountain wave) perturbation model of the original Mars-GRAM. A minor modification was also made which allows heights to go 'below' local terrain height and return 'realistic' pressure, density, and temperature, and not the surface values,

as returned by the original Mars-GRAM. This feature will allow simulations of Mars rover paths which might go into local 'valley' areas which lie below the average height of the present, rather coarse-resolution, terrain height data used by Mars-GRAM. Sample input and output of both the interactive and batch versions of Mars-GRAM are presented. Author

N92-24717*# Cornell Univ., Ithaca, NY. Dept. of Astronomy.
DYNAMICS OF THE ATMOSPHERES OF THE OUTER PLANETS Progress Report
Peter J. Gierasch and Barney J. Conrath (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.) Feb. 1992 36 p
(Grant NAG5-813)
(NASA-CR-190084; NAS 1.26:190084) Avail: NTIS HC/MF A03 CSCL 03B

Current knowledge about dynamics and the thermal structure of the outer planets is reviewed with the aim of identifying important measurements which should be made in the post-Voyager era. The existence of jets and cloud bands is the puzzle that underlies all others. The discussion focuses on the particular case of Jupiter because the documentation is the most complete. It is argued that the gross dynamical parameters of the outer planetary atmospheres are the keys to their behaviors, rather than the particular specifics of radiative forcing, cloud distributions, or thermodynamic transformations. Voyager data has shown that the jet systems decay with height in the region above the visible clouds. Therefore, the highest priority must be given to establishing dynamical parameters that characterize levels within and beneath the clouds. These require the determination of the deep structure of the jets, of the density stratification, and of the horizontal density contrasts. The deep regions are not easily accessible and these measurements present challenging opportunities. Indirect inferences about the controlling processes may sometimes be possible by observing waves and other activity in the more easily accessible stratosphere. Author

N92-24805*# State Univ. of New York, Stony Brook. Dept. of Earth and Space Sciences.
CHEMISTRY OF THE OUTER PLANETS Final Report, 15 Dec. 1984 - 14 Dec. 1991
Thomas W. Scattergood 28 May 1992 18 p
(Contract NCC2-311)
(NASA-CR-190314; NAS 1.26:190314) Avail: NTIS HC/MF A03 CSCL 03B

Various aspects were studied of past or present chemistry in the atmospheres of the outer planets and their satellites using lab simulations. Three areas were studied: (1) organic chemistry induced by kinetically hot hydrogen atoms in the region of Jupiter's atmosphere containing the ammonia cirrus clouds; (2) the conversion of NH3 into N2 by plasmas associated with entry of meteors and other objects into the atmosphere of early Titan; and (3) the synthesis of simple hydrocarbons and HCN by lightning in mixtures containing N2, CH4, and NH3 representing the atmospheres of Titan and the outer planets. The results showed that: (1) hot H2 atoms formed from the photodissociation of NH3 in Jupiter's atmosphere could account for some of the atmospheric chemistry in the ammonia cirrus cloud region; (2) the thermalization of hot H2 atoms in atmospheres predominated by molecular H is not as rapid as predicted by elastic collision theory; (3) the net quantum loss of NH3 in the presence of a 200 fold excess of H2 is 0.02, much higher than was expected from the amount of H2 present; (4) the conversion of NH3 into N2 in plasmas associated with infalling meteors is very efficient and rapid, and could account for most of the N2 present on Titan; (5) the yields of C2H2 and HCN from lightning induced chemistry in mixtures of CH4 and N2 is consistent with quenched thermodynamic models of the discharge core; and (6) photolysis induced by the UV light emitted by the gases in the hot plasmas may account for some, if not most, of the excess production of C2H6 and the more complex hydrocarbons. Author

N92-24371# Cologne Univ. (Germany, F.R.). Abt. Weltraumphysik.
MAGNETOMETER EXPERIMENTS OF THE VOYAGER MISSION [MAGNETOMETEREXPERIMENTE DER VOYAGER-MISSION]
K.-H. Glassmeier *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 61-62 In GERMAN Sponsored by Bundesministerium fuer Forschung und Technologie, and DFG (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24373# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
RESEARCH FIELD 1: PLANETARY ATMOSPHERES. PROJECT 1.1: UV SPECTROSCOPY OF THE OUTER PLANETS [ARBEITSBEREICH 1: ATMOSPHAEREN DER PLANETEN. PROJEKT 1.1: UV SPEKTROSKOPIE DER AEUSSEREN PLANETEN]
K. H. Fricke *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 65-66 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24374# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
RESEARCH FIELD 1: PLANETARY ATMOSPHERES. PROJECT 1.2: HELIUM IN THE ATMOSPHERE OF JUPITER. PROJECT 1.3: PLANET TELESCOPES. PROJECT 1.4: COMET MISSION CRAF [ARBEITSBEREICH 1: ATMOSPHAEREN DER PLANETEN: PROJEKT 1.2: HELIUM IN DER JUPITER-ATMOSPHAERE. PROJEKT 1.3: PLANETEN-TELESKOP. PROJEKT 1.4: KOMETEN-MISSION CRAF]
G. Lehmacher, U. vonZahn, and K. H. Fricke *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 67-68 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

N92-24642# Centre National d'Etudes Spatiales, Toulouse (France).
AEROSTAT FOR THE MARS 1994/1996 MISSION [L'AEROSTAT DE LA MISSION MARS 94/96]
C. Tarrieu *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 301-305 In FRENCH (For primary document see N92-24589 15-12)
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N92-24737# Academy of Sciences (USSR), Moscow. Inst. of Applied Mathematics.
NAVIGATION FOR A RADAR MAPPING SATELLITE OF VENUS
E. L. Akim, V. A. Stepanyants, and Z. P. Vlasova *In* ESA, Spacecraft Flight Dynamics Dec. 1991 p 127-132 (For primary document see N92-24719 15-12)
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92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N92-24960# Helsinki Univ. of Technology, Kylmaelae (Finland). Metsaehovi Radio Research Station.

SOLAR MICROWAVE RADIATION MAPS MEASURED AT METSAEHOVI RADIO RESEARCH STATION IN 1990

S. Urpo, S. Pohjolainen, H. Teraesranta, and K. Karlamaa 1991 127 p

(PB92-138056; ISBN-951-22-0755-9; SER-A-7) Avail: NTIS HC/MF A07 CSCL 03B

The Metsaehovi Radio Research Station operates a 14 m diameter radio telescope. Annually, the telescope is reserved for solar measurements for 4-10 weeks, typically during summer months. Measurements include maps of the whole or part of the Sun, tracking of active regions, and solar oscillation monitoring. Most of the solar maps were measured using receivers operating at 36.8 GHz. The sensitivity of receivers is good enough for 0.2 sfu resolution. In the temperature scale the resolution is better than 100 K and it is limited by short term changes in the atmospheric attenuation. The purpose of the report series is to publish at least one map for each of the days when measurements were performed. For some of these days, there exist several measured maps. The volume contains selected maps measured in 1990. A list of all measured maps during this period is included. GRA

N92-24649# Bonn Univ. (Germany, F.R.). Inst. fuer Astronomie.

OBSERVATION OF THE SOLAR LYMAN-ALPHA LINE

H. U. Nass, G. Lay, and Hans J. Fahr *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 343-347 (For primary document see N92-24589 15-12)

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N92-24650# Bonn Univ. (Germany, F.R.). Inst. fuer Astrophysik und Extraterrestrische Forschung.

THE PROBLEM OF THE OXYGEN PRESENCE IN THE HELIOSPHERE AND OBSERVATIONAL IMPLICATIONS

Hans J. Fahr *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 349-354 (For primary document see N92-24589 15-12)

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N92-24653# Centre National de la Recherche Scientifique, Verrieres-Le Buisson (France). Inst. d'Astrophysique Spatiale.

PHOTOSPHERIC LINES REDSHIFT FROM BALLOON ULTRAVIOLET SPECTRA OF THE QUIET SUN

D. Samain *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 363-366 Prepared in cooperation with Paris VI Univ., Fran ce (For primary document see N92-24589 15-12)

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93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

N92-25100*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

MIRACAL: A MISSION RADIATION CALCULATION PROGRAM FOR ANALYSIS OF LUNAR AND INTERPLANETARY MISSIONS

John E. Nealy, Scott A. Striepe, and Lisa C. Simonsen Washington May 1992 16 p

(NASA-TP-3211; L-17044; NAS 1.60:3211) Avail: NTIS HC/MF A03 CSCL 03B

A computational procedure and data base are developed for manned space exploration missions for which estimates are made for the energetic particle fluences encountered and the resulting dose equivalent incurred. The data base includes the following options: statistical or continuum model for ordinary solar proton events, selection of up to six large proton flare spectra, and galactic cosmic ray fluxes for elemental nuclei of charge numbers 1 through 92. The program requires an input trajectory definition information and specifications of optional parameters, which include desired spectral data and nominal shield thickness. The procedure may be implemented as an independent program or as a subroutine in trajectory codes. This code should be most useful in mission optimization and selection studies for which radiation exposure is of special importance. Author

N92-24364# Gesamthochschule, Siegen (Germany, F.R.). Fachbereich Physik.

RADIATION EFFECTS DURING SPACE MISSIONS [STRAHLENEFFEKTE BEI RAUMFLUGMISSIONEN]

W. Heinrich *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 43-45 In GERMAN (For primary document see N92-24351 15-99)

Avail: NTIS HC/MF A08

N92-24648# Bonn Univ. (Germany, F.R.). Inst. fuer Astrophysik und Extraterrestrische Forschung.

CONTAMINATION OF TERRESTRIAL EUV OBSERVATIONS BY ENERGETIC PARTICLES

G. Lay, H. U. Nass, and Hans J. Fahr *In* ESA, 10th ESA Symposium on European Rocket and Balloon Programmes and Related Research Nov. 1991 p 339-342 (For primary document see N92-24589 15-12)

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99 GENERAL

N92-24351# Minister fuer Wirtschaft, Mittelstand und Verkehr des Landes Nordrhein, Westfalen (Germany, F.R.).

SUBJECT SPACE 2: A DOCUMENTATION ON SPACE RESEARCH IN NORTH-RHINELAND-WESTPHALIA IN THE PERIOD 1985-1990 [THEMA WELTRAUM 2: EINE DOKUMENTATION DER WELTRAUMFORSCHUNG IN NORDRHEIN-WESTFALEN IN DEN JAHREN 1985-1990]

Dec. 1990 157 p In GERMAN

(ETN-92-91068) Avail: NTIS HC/MF A08

Subjects in the field of Earth observation, satellite communication, astronomy, astrophysics, geophysics, planetary physics, development of orbital systems and robotics, space transportation systems, and flow simulation are discussed. Much of the research, presented herein, is not yet completed. Therefore,

the abstracts were not treated in the usual way. For individual titles, see N92-24352 through N92-24396.

N92-24352# Bonn Univ. (Germany, F.R.). Inst. fuer Geographie.
STUDIES OF FOG IN THE ALPS USING DIGITAL SATELLITE DATA [NEBELSTUDIEN IM ALPENRAUM MIT DIGITALEN SATELLITENDATEN] **c47**
M. Bachmann and J. Bendix *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 15-16 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The space-time distribution of fog on the Alps and the Lower Alps was investigated using digital satellite data from the geosynchronous NOAA/AVHRR (Advanced Very High Resolution Radiometer) system. Data from the different spectral ranges are used to develop a simple, automatic fog recognition procedure with a view to the simplification of climatological studies and the design of a fog warning system. The main difficulty lies in the separation of snow, higher clouds, and fog. ESA

N92-24353# Bonn Univ. (Germany, F.R.). Inst. fuer Geographie.
DETERMINATION OF PRECIPITATION FROM METEOSAT DATA [NIEDERSCHLAGSBESTIMMUNG AUS METEOSAT-DATEN] **c47**
G. Menz and A. Vaculik *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 17-18 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

A precipitation map for natural savannah landscapes in Kenya was established using real time Meteosat data. The map was developed in order to improve the understanding of the complex interactions between climate and vegetation. The data have a maximum time resolution of 30 minutes and a spatial resolution of 5 by 7 sq km. Using several stochastic and physical models, precipitation maps can be produced numerically with high accuracy. The results demonstrate the applicability of digital Meteosat data for the establishment of precipitation maps in tropical regions with a dominantly convective precipitation regime. ESA

N92-24354# Muenster Univ. (Germany, F.R.). Abt. Landschaftsoekologie.
DEVELOPMENT OF A PC-AIDED IMAGE PROCESSING SYSTEM FOR ENVIRONMENT MANAGEMENT [ENTWICKLUNG EINES PC-GESTUETZTEN BILDVERARBEITUNGSSYSTEMS FUER DIE UMWELTPLANUNG] **c45**
U. Streit, S. Bender, P. Kempa, and K. Wiesmann *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 19-20 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

A low cost image processing system, BIVAS, was developed for the preparation, statistical analysis, classification, management, and representation of digital remote sensing data. This modular system can be used on current personal computers. Additionally, applied practical procedures and new approaches for digital image processing are developed with a view to the solution of regional environmental problems. ESA

N92-24355# Cologne Univ. (Germany, F.R.). Lehrstuhl fuer Wirtschaftsinformatik.
ECONOMICAL ASPECTS OF SATELLITE APPLICATION SYSTEMS FOR COMMERCIAL COMMUNICATION [WIRTSCHAFTLICHKEITSASPEKTE VON SATELLITENANSWENDUNGSSYSTEMEN IN DER GESCHAEFTLICHEN KOMMUNIKATION] **c83**
D. Seibt *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 23 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

Economical aspects of Private Satellite Networks (PSNs) were studied with a view to application to large and medium size companies. Applicability, feasibility, efficiency, and risks were analyzed. The results are the basis for the conception of typical, operational satellite application systems. Special emphasis is placed on the integration of future PSNs in existing telecommunication infrastructures. ESA

N92-24356# Bonn Univ. (Germany, F.R.). Inst. fuer Radioastronomie.
DAN: COMPUTER NETWORK FOR THE IMAGE PROCESSING OF SATELLITE DATA [DAN: DEUTSCHES ASTRO-NETZ] **c62**
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 27-28 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The computer network DAN (German acronym for German astronomical network) is being established in order to standardize image processing systems and to improve the collaboration between institutes of astronomy in Germany. A coordinated software development and a common connection to a data network are required. It is decided to use the modular software package, MIDAS (Munic Interactive Data Analysis), of the European Space Agency. ESA

N92-24357# Observatorium Hoher List, Daun (Germany, F.R.).
EARTH ROTATION AND OCEANS: EFFECTS OF TIDES AND OCEAN FLOWS ON THE POSITION OF THE EARTH IN SPACE [ERDROTATION UND OZEANE: EINFLUESSE VON GEZEITEN UND OZEANISCHEN STROEMUNGEN AUF DIE STELLUNG DER ERDE IM RAUM] **c48**
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 29-30 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The effects of oceanic geophysical processes on the Earth's rotation were investigated using highly precise VLBI (Very Long Base Interferometry) data. Global changes of the total angular momentum and hence of the Earth's position were determined from the changes of the ocean level provided by hydrodynamical models, and from the velocities of the water masses. The small signals in the VLBI data which are due to ocean holes were determined. ESA

N92-24358# Sternwarte Bonn (Germany, F.R.).
ASTROMETRY FOR HIPPARCOS: PREPARATORY AND ACCOMPANYING GROUND-BASED CONTRIBUTIONS TO THE 1ST EMISSION OF THE ASTROMETRY SATELLITE [ASTROMETRIE FUER HIPPARCOS. VORBEREITENDE UND BEGLEITENDE ERDGEBUNDENE BEITRAEGE ZUR MISSION DES ERSTEN ASTROMETRIE-SATELLITEN] **c90**
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 31-32 In GERMAN (For primary document see

N92-24351 15-99)
Avail: NTIS HC/MF A08

Astrometry contributions were made during the first mission of the European satellite Hipparcos. The contributions were aimed at establishing an inertial reference system. Additionally, the contributions provide data for the registration of the components of double stars, data concerning the Milky Way and galactic clusters, and data for the connection between the preliminary reference and extragalactic objects. The relative motion of Hipparcos stars, with respect to quasars, was determined for the extragalactic calibration of the Hipparcos system. ESA

N92-24359# Sternwarte Bonn (Germany, F.R.).
STUDY OF THE KINEMATICS OF GASES IN THE MILKY WAY [UNTERSUCHUNG DER KINEMATIK DER GASE DER MILCHSTRASSE] **c90**
K. S. deBoer *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 33-34 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The position and condition of the motion of gas clouds in the Milky Way were investigated using ultraviolet absorption spectroscopic data provided by the International Ultraviolet Explorer (IUE) satellite. The first aim is the investigation of the effect on solar radiation on Earth of a motion of the planetary system into a gas cloud in the neighborhood of the Sun. The second aim is the testing of motion and development models for the Milky Way galaxy. ESA

N92-24360# Muenster Univ. (Germany, F.R.). Inst. fuer Astronomie.
PARTICIPATION OF THE MUENSTER UNIVERSITY INSTITUTE OF ASTRONOMY (AIM) IN SPACE PROJECTS [TEILNAHME DES ASTRONOMISCHEN INSTITUTS DER UNIVERSITAET MUENSTER (AIM) AN RAUMFAHRPROJEKTEN] **c90**
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 35-36 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The Muenster University Institute of Astronomy (AIM) participated in several astronomy projects. In the field of ultraviolet (UV) astronomy, AIM participated from the start in the International Ultraviolet Explorer (IUE) program, and performed UV measurements of novae, continuum, and like spectral measurements for the determination of temperatures, and UV measurements of Novae envelopes (including the discovery of the strong 124 nm line of four times ionized nitrogen). The contributions to X-ray astronomy, with the ROSAT satellite, include the study of intergalactic matter, analysis of survey data for galactic clusters, and general optical investigations. Astrometric measurements were performed from the Hipparcos satellite to determine the galactic rotation. ESA

N92-24361# Cologne Univ. (Germany, F.R.). Inst. fuer Physik.
PHYSICS AND CHEMISTRY OF INTERSTELLAR CLOUDS: KOELNER OBSERVATORY FOR SUBMILLIMETER ASTRONOMY (KOSMA) [DIE PHYSIK UND CHEMIE INTERSTELLARER WOLKEN: KOELNER OBSERVATORIUM FUER SUBMILLIMETER-ASTRONOMIE-KOSMA] **c90**
G. Winnewisser, R. Schieder, and J. Stutzki *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 37-38 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

Contributions were made to the spectroscopic investigation of the atomic and molecular composition, the dynamics, and the general physical characteristics of interstellar matter. Structure and dynamics of interstellar molecular clouds, boundary layers between molecular and ionized matter, and the chemical composition of molecule clouds were studied. Molecule observations in external galaxies were made, and their dynamics were compared to those of the Milky Way. Atmospheric molecules such as CO and ozone were observed for the study of dynamic processes in the atmosphere. ESA

N92-24362# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
INVESTIGATION OF THE APPLICATION OF SIS ELEMENTS IN THE SUBMILLIMETER RANGE (ABOVE 300 GHz), AND DEVELOPMENT OF THE TECHNOLOGY FOR HIGH SENSITIVITY RECEIVERS WITH A VIEW TO THE MISSION FIRST [UNTERSUCHUNG ZUR ANWENDUNG VON SIS-ELEMENTEN IM SUBMILLIMETERBEREICH (GREATER THAN 300 GHZ) UND ENTWICKLUNG DER TECHNOLOGIE HOCHEMPFINDLICHER EMPFAENGER IM HINBLICK AUF DIE FIRST MISSION] **c89**
P. G. Metzger *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 39-40 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The superconductor insulator superconductor (SIS) receiver technology was further developed for higher frequencies and higher sensitivities with a view to the FIRST (Far Infrared and Submillimeter Space Telescope) project. An SIS mixer and coupling antenna were integrated by planar technique on a substrate and successfully tested. A suitable antenna type was selected, and the antenna parameters were determined experimentally. A prototype receiver was integrated in a helium cryostat. ESA

N92-24363# Max-Planck-Inst. fuer Radioastronomie, Bonn (Germany, F.R.).
DEVELOPMENT OF A SUBMILLIMETER/FAR INFRARED HETERODYNE SPECTROMETER: TESTING ON SPACECRAFT AS A PREPARATION FOR THE FIRST PROJECT [ENTWICKLUNG EINES SUBMM/FIR-HETERODYN-SPEKTROMETERS; ERPROBUNG MIT ASTROFLUGZEUGEN ZUR VORBEREITUNG AUF FIRST] **c35**
P. G. Metzger *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 41-42 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

A heterodyne spectrometer for the wavelength region between 100 and 500 microns was developed as preparation for the FIRST (Far Infrared and Submillimeter Space Telescope) project. Since no low noise amplifiers exist in this region, the incoming signal is mixed down to a microwave frequency and then spectrally analyzed in an acousto-optical spectrometer. The heterodyne spectrometer was used on the KAO (Kuiper Airborne Observatory) of NASA for the observation of the Orion nebula. ESA

N92-24364# Gesamthochschule, Siegen (Germany, F.R.). Fachbereich Physik.
RADIATION EFFECTS DURING SPACE MISSIONS [STRAHLENEFFEKTE BEI RAUMFLUGMISSIONEN] **c93**
W. Heinrich *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 43-45 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

Space experiments were performed to measure cosmic particle fluxes for missions with different orbits in the Earth magnetic field. This field partly shields the cosmic radiation, but simultaneously confines low energy particles in the radiation belts. The measured data were compared with model calculations for the further

development of the latter. During space missions and in acceleration experiments radiation effects in biological objects were analyzed for cosmic particles with different charge and energy. A testing system for the study of radiation effects in semiconductor storage elements was developed. ESA

N92-24365# Bonn Univ. (Germany, F.R.). Inst. fuer Astrophysik und Extraterrestrische Forschung.
INSTITUTE OF ASTROPHYSICS AND EXTRATERRESTRIAL RESEARCH OF THE RHINELAND FRIEDRICH-WILHELM BONN UNIVERSITY (GERMANY, F.R.): RESEARCH FIELD OF INTERPLANETARY SPACE AND SOLAR WIND [DAS INSTITUT FUER ASTROPHYSIK UND EXTRATERRESTRISCHE FORSCHUNGDER RHEINISCHEN FRIEDRICH-WILHELMS UNIVERSITAET] **c90**
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 47-48 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

In the field of astrophysics, subjects concerning galactic winds, cosmology, double star wind, and general relativity theory are studied. Contributions to the study of the upper atmosphere are made. Theoretical studies of the solar wind, and of the distribution of interstellar neutral gases on the heliosphere are performed. ESA

N92-24366# Bonn Univ. (Germany, F.R.). Inst. fuer Astrophysik und Extraterrestrische Forschung.
AERONOMIC STUDIES WITH THE SAN MARCO D/ITG: ODA AND ASSI [AERONOMIE MIT SAN MARCO D/ITG: ODA UND ASSI] **c90**
M. Roemer *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 49-52 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

Contributions to the study of the aeronomy of the terrestrial thermosphere using the research satellite San Marco D/Itg were made. The aim was to explore the time-space behavior of thermosphere and ionosphere during interaction with solar radiation and solar wind. The software experiment ODA determines the gas density in the perigee of the satellite orbit from the orbit change. The solar spectrometer ASSI measures solar radiation from the extreme ultraviolet (EUV) to the visible range, as well as airglow in the EUV to determine the space-time behavior of oxygen and nitrogen. ESA

N92-24367# Gesamthochschule, Wuppertal (Germany, F.R.). Fachbereich Naturwissenschaften.
SISSI: SPECTROSCOPIC INFRARED STRUCTURE SIGNATURES INVESTIGATION [SISSI: SPECTROSCOPIC INFRARED STRUCTURE SIGNATURES INVESTIGATION] **c90**
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation in Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 53-54 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The project SISSI studies trace gas distributions and nonthermal excitation mechanisms in the mesosphere and the lower thermosphere of the Earth (50 to 200 km). The main SISSI payload is an Ebert-Fastie type IR spectrometer cooled with liquid helium. The energy budget of the upper Earth's atmosphere is essentially determined by IR radiation cooling. The preliminary results justify the expectation of new findings. ESA

N92-24368# Cologne Univ. (Germany, F.R.). Abt. Weltraumphysik.
MAGNETIC FIELD EXPERIMENT OF THE CLUSTER MISSION: INVESTIGATIONS OF SPATIAL STRUCTURES IN THE EARTH MAGNETOSPHERE [MAGNETFELDEXPERIMENT DER CLUSTER-MISSION: UNTERSUCHUNGEN VON RAEUMLICHEN STRUKTUREN IN DER MAGNETOSPHAERE DER ERDE] **c90**
R. V. Stein *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 55-56 In GERMAN Sponsored by Bundesministerium fuer Forschung und Technologie (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

Plasma boundary layers and wave phenomena in the Earth magnetosphere are studied using the satellite array of the Cluster mission. In the Earth magnetosphere a multitude of dynamic phenomena occur due to solar perturbations or to instabilities of the global magnetosphere structure. A special satellite data processing center and special programs for the simulation of physical processes are required. ESA

N92-24369# Cologne Univ. (Germany, F.R.). Abt. Weltraumphysik.
MAGNETIC FIELD EXPERIMENTS OF THE TSS-1 MISSION: INVESTIGATIONS OF THE ELECTRODYNAMICS OF A TETHERED SATELLITE [MAGNETFELDEXPERIMENTE DER TSS-1-MISSION: UNTERSUCHUNGEN ZUR ELEKTRODYNAMIK EINES SEILGEFESSELTEN SATELLITENSYSTEMS] **c90**
A. Luettgen and H. Marschall *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 57-58 In GERMAN Sponsored by Bundesministerium fuer Forschung und Technologie (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The evaluation of data from the magnetometer-experiment of the subsatellite TSS-1, connected with the Space Shuttle, is prepared, and kinetic plasma model predictions concerning the perturbations field of the electrodynamic TSS-1 in the ionospheric plasma are made. The far field wave solution in the ionospheric plasma is being established. The complex problem of the plasma distribution around subsatellites considered as anodes is treated using kinetic models. ESA

N92-24370# Cologne Univ. (Germany, F.R.). Abt. Weltraumphysik.
MAGNETOMETER EXPERIMENT OF THE ESA MISSION GIOTTO: TECHNICAL REALIZATION, DATA EVALUATION AND INTERPRETATION OF THE MAGNETIC FIELD DATA OF THE PASSING FLIGHT OF HALLEY'S COMET [MAGNETOMETEREXPERIMENT DER ESA-MISSION GIOTTO: TECHNISCHE DURCHFUEHRUNG, DATENAUSWERTUNG UND -INTERPRETATION DER MAGNETFELDDATEN DES VORBEIFLUGS AM KOMETEN HALLEY] **c90**
K.-H. Glassmeier and J. Raeder *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 59-60 In GERMAN Sponsored by Bundesministerium fuer Forschung und Technologie (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The evaluation of the data from a magnetometer experiment of the Giotto mission, and their scientific interpretations are performed. The emphasis was on the study of magnetic field perturbations due to the interaction between the interplanetary plasma and the cometary atmosphere and ionosphere. The magnetometer was designed, constructed, tested, calibrated, and integrated in Giotto. Two and three dimensional magnetohydrodynamic model calculations were performed. ESA

N92-24371# Cologne Univ. (Germany, F.R.). Abt. Weltraumphysik.
MAGNETOMETER EXPERIMENTS OF THE VOYAGER MISSION [MAGNETOMETEREXPERIMENTE DER VOYAGER-MISSION] **c91**
K.-H. Glassmeier *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 61-62 In GERMAN Sponsored by Bundesministerium fuer Forschung und Technologie, and DFG (For primary document see N92-24351 15-99)
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Magnetometer measurements on large planets and satellites of the outer solar system were analyzed and model calculations were performed. The aims were to obtain physical information about the interior of the planets and the interaction of satellites with their plasma environment, as well as the investigation of interplanetary plasmas and the boundary between the interplanetary and interstellar medium. Simple models were developed for the analysis of the measurements, and three dimensional magnetohydrodynamic model calculations were performed using numerical methods. Fundamental plasma physics phenomena were revealed, and in interplanetary space the variation of the solar magnetic field as a function of the distance to the Sun was determined. ESA

N92-24372# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
ATMOSPHERE AND SPACE RESEARCH AT THE INSTITUTE OF PHYSICS, BONN UNIVERSITY (GERMANY, F.R.) [ATMOSPHAEREN- UND WELTRAUMFORSCHUNG AM PHYSIKALISCHEN INSTITUT DER UNIVERSITAET BONN] **c46**
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 63 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The study group for atmospheres and space research investigates physical and chemical processes in the atmospheres of Earth and planets. Gas analyzers (mass spectrometers), ionization manometers, optical analysis instruments (IR interferometer, UV spectrometer and lasers), falling sphere, and foil clouds are used. The measurements are performed from ground, rockets, satellites and NASA space probes. ESA

N92-24373# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
RESEARCH FIELD 1: PLANETARY ATMOSPHERES. PROJECT 1.1: UV SPECTROSCOPY OF THE OUTER PLANETS [ARBEITSBEREICH 1: ATMOSPHAEREN DER PLANETEN. PROJEKT 1.1: UV SPEKTROSKOPIE DER AEUSSEREN PLANETEN] **c91**
K. H. Fricke *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 65-66 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The long term stability of the Lyman alpha emission of atomic hydrogen in the upper atmospheres of Jupiter, Neptune, Saturn and Uranus are investigated using the International Ultraviolet Explorer (IUE) satellite. Radiation transport calculations (taking into account Raman scattering) on Neptune and Uranus spectra show that the 'rest noise' in the spectral albedo is mainly due to Fraunhofer emission lines. The preliminary analysis of Neptune spectra shows no modulation of the albedo with the rotation of Neptune, within the accuracy of the measurements. The spots and band in the atmosphere of Neptune discovered by the Voyager camera probably do not extend into the pressure range probed by IUE. ESA

N92-24374# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
RESEARCH FIELD 1: PLANETARY ATMOSPHERES. PROJECT 1.2: HELIUM IN THE ATMOSPHERE OF JUPITER. PROJECT 1.3: PLANET TELESCOPES. PROJECT 1.4: COMET MISSION CRAF [ARBEITSBEREICH 1: ATMOSPHAEREN DER PLANETEN: PROJEKT 1.2: HELIUM IN DER JUPITER-ATMOSPHAERE. PROJEKT 1.3: PLANETEN-TELESKOP. PROJEKT 1.4: KOMETEN-MISSION CRAF] **c91**
G. Lehmacher, U. vonZahn, and K. H. Fricke *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 67-68 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

A modified Jamin interferometer is being developed to determine the helium content of the Jupiter atmosphere in the framework of the NASA Galileo mission, with a view to a better understanding of the inner structure of Jupiter, the thermal characteristics of its atmosphere, and the evolution of Jupiter and the whole solar system. The planned characteristics of the planet telescope are: a broad spectral range from UV to IR, an angular resolution of 0.1 seconds of arc, and a high orbit. For the comet mission, a CRAF subsystem is being developed for a mass spectrometer experiment for the study of the gas and ion composition in the coma of planets. The subsystem has to calibrate the absolute sensitivity of instruments during the interplanetary flight, and calibrate the mass spectrometer in the laboratory. ESA

N92-24375# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
RESEARCH FIELD 2: INVESTIGATIONS OF THE MIDDLE EARTH ATMOSPHERE USING HIGH ALTITUDE RESEARCH ROCKETS. PROJECT 2.1: THE PROJECTS MAC/SINE AND MAC/EPSILON [ARBEITSBEREICH 2. UNTERSUCHUNGEN DER MITTLEREN ATMOSPHAERE DER ERDE MITTELS HOEHENFORSCHUNGSRAKETEN. PROJEKT 2.1: DIE PROJEKTE MAC/SINE UND MAC/EPSILON] **c46**
H. Baumann, W. Hillert, F.-J. Luebken, W. Meyer, R. Siebenmorgen, and U. vonZahn *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 69 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The correlation between the average status of the atmosphere and small scale, turbulent perturbations in the mesosphere and lower thermosphere was investigated. In the MAC/SINE (Middle Atmosphere Cooperation/Summer In Northern Europe) campaign, passive falling spheres were used for temperature profile measurements in the mesosphere; the variability of the temperature in the upper mesosphere was found to be astonishingly low. In the MAC/EPSILON campaign falling spheres, rocket borne mass spectrometers, and a novel ionization manometer were used to determine the turbulent state of the lower thermosphere. Ground measurements of the temperature in the upper mesosphere using a sodium lidar show excellent agreement with other measurements. ESA

N92-24376# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
RESEARCH FIELD 2: INVESTIGATIONS OF THE MIDDLE EARTH ATMOSPHERE USING HIGH ALTITUDE RESEARCH ROCKETS. PROJECT 2.2: ROSE. PROJECT 2.3: TURBO [ARBEITSBEREICH 2: UNTERSUCHUNGEN DER MITTLEREN ATMOSPHAERE DER ERDE MITTELS HOEHENFORSCHUNGSRAKETEN. PROJEKT 2.2: DAS PROJEKT ROSE. PROJEKT 2.3: DAS PROJEKT TURBO] **c46**
A. Friker, F.-J. Luebken, U. vonZahn, H. Baumann, W. Hillert, and G. Lehmacher *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A

Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 70 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

Instruments were developed for high altitude rocket experiments in the ionosphere and mesosphere. In the framework of the rocket campaign ROSE (ROcket and Scatter Experiments) four ionization manometers (TOTAL) were prepared and calibrated for the measurements of air temperature and density between 90 and 105 km. Eight TOTAL instruments were built, tested and calibrated for the study of turbulence phenomena in the upper mesosphere. ESA

N92-24377# Bonn Univ. (Germany, F.R.). Arbeitsgruppe fuer Atmosphaeren- und Weltraumforschung.
RESEARCH FIELD 2: INVESTIGATIONS OF THE MIDDLE EARTH ATMOSPHERE USING HIGH ALTITUDE RESEARCH ROCKETS. PROJECT 2.4: MASERATI [ARRBEITSBEREICH 2. UNTERSUCHUNGEN DER MITTLEREN ATMOSPHAERE DER ERDE MITTELS HOEHENFORSCHUNGSRAKETEN. PROJEKT 2.4: DAS PROJEKT MASERATI] **c46**
F.-J. Luebken and D. Rebscher *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 71 In GERMAN (For primary document see N92-24351 15-99)
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The rocketborne IR diode laser experiment MASERATI (Middle Atmosphere Spectrometric Experiment on Rockets for Analysis of Trace gas Influences) is being prepared for the absorption spectroscopy study of pressure broadening of spectral lines. The usefulness of the diode lasers and the optical components for rocket experiments was demonstrated. The most suitable optical design of the absorption cell is prepared. ESA

N92-24378# Bonn Univ. (Germany, F.R.).
RESEARCH FIELD 3: INVESTIGATIONS OF THE MIDDLE EARTH ATMOSPHERE WITH LASERS. PROJECT 3.1: TEMPERATURES AT HEIGHTS BETWEEN 80 AND 100 km [ARBEITSBEREICH 3: UNTERSUCHUNGEN DER MITTLEREN ATMOSPHAERE DER ERDE MITTLES LASER. PROJEKT 3.1: TEMPERATUREN IM HOEHENBEREICH 80 BIS 110 KM] **c46**
M. Alpers, K. H. Fricke, P. vonderGathen, G. Hansen, H. Kurzawa, M. Serwazi, C. Tilgner, and U. vonZahn *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 72 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

A lidar experiment was performed to determine temperature profiles in the mesopause. The measuring apparatus contains a powerful (2 MW pulses), very narrow band (about 0.13 pm) and tunable laser. Free Na-atoms between 80 and 110 km are excited to resonance fluorescence which is observed on Earth with a telescope to deduce the atmospheric temperature. The Winter campaign shows temperatures lower than expected. ESA

N92-24379# Bonn Univ. (Germany, F.R.).
RESEARCH FIELD 3: INVESTIGATIONS OF THE MIDDLE EARTH ATMOSPHERE WITH LASERS. PROJECT 3.2: INVESTIGATION OF IRON DENSITIES. PROJECT 3.3: MEASUREMENTS OF THE TEMPERATURE OF THE POLAR STRATOSPHERE [ARBEITSBEREICH 3: UNTERSUCHUNGEN DER MITTLEREN ATMOSPHAERE DER ERDE MITTELS LASER. PROJEKT 3.2: UNTERSUCHUNG VON EISENSCHICHTEN. PROJEKT 3.3: MESSUNGEN DER TEMPERATUR DER POLAREN STRATOSPHAERE] **c46**
M. Alpers, J. Hoeffner, U. vonZahn, K. H. Fricke, J. Schaefer, and P. Scheuch *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 73 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

A lidar experiment is prepared for the measurement of temperatures and aerosol content of the stratosphere. The atmospheric temperature affects the velocity of the photochemical reactions involved in the production of ozone in the ozone layer. The method combines spectral analysis of the Cabanne line with Mie, Rayleigh and Raman scattering. The optical design and the data analysis are prepared. Another lidar experiment is prepared for the identification of a layer of free iron atoms at a height between 85 and 105 km, released by evaporation of cosmic dust. ESA

N92-24380# Dortmund Univ. (Germany, F.R.). Inst. fuer Roboterforschung.
THE INSTITUTE FOR ROBOTICS (IRF) [IRF: INSTITUT FUER ROBOTERFORSCHUNG] **c37**
E. Freund *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 77-79 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The activities of the Institute for Robotics of the University of Dortmund (Germany, F.R.) are presented. The focal points are the development of new methods for the control of complex multirobot systems, and their realization and application in automated systems. Knowledge based diagnosis methods and expert systems are being used more and more. The present range of activities comprises nonlinear control, sensor driven trajectory control, online trajectory determination, multirobot systems, simulation and automatic programming, machine intelligence, automatic vehicle control, and space robot systems. ESA

N92-24381# Dortmund Univ. (Germany, F.R.). Inst. fuer Roboterforschung.
CONTROL OF MODULAR AUTOMATION OF ROBOTICS SYSTEM (MARS) [MARS-STEUERUNG: MODULARES AUTOMATION UND ROBOTIK SYSTEM TESTBED] **c37**
E. Freund *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 81-82 In GERMAN (For primary document see N92-24351 15-99)
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This project implies the development of an open, modular control system for the MARS (Modular Automation of Robotics System) testbed on which automation techniques for the Columbus module have to be investigated. The planned system is a basic version, which can later be extended in a modular way with a view to multirobot systems and intelligent higher stages. The basic version contains three main components: robot control, grab control, and collision protection and avoidance for which a model description and a software module were developed. ESA

N92-24382# Gesamthochschule, Paderborn (Germany, F.R.). Fachbereich Automatisierungstechnik.
DEVELOPMENT OF THE LINKAGE CONTROLLER FOR THE ROTEX ROBOT [ROTEX: ENTWICKLUNG DER GELENKREGLER FUER DEN ROTEX-ROBOTER] **c37**
W. Moritz and R. Neumann *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 83-84 In GERMAN (For primary document see N92-24351 15-99)
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The development and optimization of models for the ROTEX (Robot Technology Experiment) robot and local trajectory controllers are discussed. The control concept is limited to local linear low order controller with low scanning frequency for each of the six axes of the manipulator arm, implemented into a Spacelab rack. The required calculation time has to be low, but the flexibility

high so as to allow control from the ground station starting from theoretical and experimental models, the mechanical equations of motion of the whole robot were deduced in symbolic form. The model contains robot and controllers and allows the study of the function of the proposed control using dynamic simulation. ESA

N92-24383# Gesamthochschule, Paderborn (Germany, F.R.). Inst. fuer Automatisierungstechnik.
DEVELOPMENT OF CARBON FIBER REINFORCED PLASTICS ROBOTS [ENTWICKLUNG VON CFK-ROBOTERN] c37
M. Stark, M. Stoeger (Technische Hochschule, Aachen, Germany, F.R.), and W. Moritz *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation in Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 85-86 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The use of Carbon Fiber Reinforced Plastics (CFRP) in robots is under investigation with a view to the improvement of the dynamic characteristics and the vibration damping, the development of the control of elastic behavior compensation, and the improvement of the accuracy. The characteristics of CFRP are especially useful for the extreme conditions in space, although the present investigations can also be useful for other domains such as machine construction, and flexible complex systems which require a high degree of accuracy and dynamics. ESA

N92-24384# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Leichtbau.
STRUCTURAL MECHANICS INVESTIGATIONS FOR THE TELMAN TELESCOPE MANIPULATOR ARM [STRUKTURMECHANISCHE UNTERSUCHUNGEN FUER DEN TELESKOPMANIPULATORARM TELMAN] c37
S. Zurhorst and A. Rittweger *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 87-88 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

Calculation methods were developed to describe the strength, stiffness, and vibration characteristics of a telescopic arm segment of a carbon fiber reinforced plastics robot arm for the Columbus project. For the description of the interaction between two thin walled tubes with anisotropic properties, the method of transfer matrices is used as a computer time saving and cheap completion of the finite element method. ESA

N92-24385# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Leichtbau.
LARGE TRUSS STRUCTURES IN SPACE [GROSSE FACHWERKSTRUKTUREN IM WELTRAUM] c31
A. Rittweger *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 89-90 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

Mathematical models were developed to study the dynamic behavior of large truss structure for space applications, taking into account the geometric imperfection of the long, slim beams, required to minimize the number of joints. These imperfections lead to nonlinear elastic spring characteristics, whereby the stiffness deviates fundamentally from that of perfect structures, already at the smallest amplitudes. The parameter studies show that the effects of the imperfections are so fundamental that space stations with such slim beams require active control. ESA

N92-24386# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Leichtbau.
DYNOST: DYNAMICS OF SURFACE TENSION TANKS [DYNOST: DYNAMIK VON OBERFLAECHENSPANNUNGSTANKS] c34
A. Rittweger *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 91-92 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

A computer program DYNOST is being developed for the dynamic analysis of surface tension fuel tanks for satellites. The coupling between the degrees of freedom of the liquid in the tank and the degrees of freedom for the structure requires a modeling which even with supercondutors does not lead to solutions. To contribute to the reduction of the degrees of freedom, in DYNOST the transfer matrix for an axisymmetric shell with arbitrary meridian is developed. ESA

N92-24387# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Leichtbau.
DETERMINATION OF THE STRUCTURAL WEIGHT OF SPACECRAFT [ERMITTLUNG DES STRUKTURGEWICHTES VON RAUMFLUGZEUGEN] c18
J. Albus *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 93-94 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

Models are being developed for a reliable estimation of the structural weight of spacecrafts, based on a preliminary design, with a view to an optimization of the configuration. Calculation methods are based on transfer matrices. Several stability analysis methods can be used, taking into account imperfections and plasticity. Interaction equations provide the stability limits in case of combined loads. A programming system for the design of axisymmetric cryogenic fuel tanks was developed. Analytical-empirical mass analysis methods as well as methods for the determination of maneuver, gust, and landing loads are being developed. ESA

N92-24388# Technische Hochschule, Aachen (Germany, F.R.). Lehrstuhl Informatik.
DFG RESEARCH PROJECT SATELLITE NETWORKS AND ISDN [DFG-FORSCHUNGSVORHABEN SATELLITENNETZE UND ISDN] c32
O. Spaniol, U. Quernheim, M. Aghadavoodi Jolfaei, and D. Kreuer *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 95-98 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

An error correction method PCR (Preventive Cyclic Retransmission) was developed for distances with long signal time of flight (longer than 15 ms). The application of the PCR method in the signalling system number 7 shows that due to too narrow windows only 20 percent of the channel capacity can be used for useful data, while 80 percent is used for protocol data, and that the delay times increase drastically with increasing loads. These problems can be overcome by modified repetition procedures and larger windows. The use of adaptive error protection methods guarantees the required quality of the data transmission. ESA

N92-24389# Gesamthochschule, Duisburg (Germany, F.R.).
MODELING AND SIMULATION OF COMPLEX MECHANICAL SYSTEMS FOR SPACE APPLICATIONS [MODELLIERUNG UND SIMULATION KOMPLEXER MECHANISCHER SYSTEME MIT ANWENDUNGEN IN DER RAUMFAHRT] c18
M. Hiller *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 99 In GERMAN (For primary document see N92-24351 15-99)
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In the framework of the research program 'Dynamics of Multibody systems', methods are being developed for the modeling

and simulation of complex space systems (such as satellites, large antennas, and space stations) characterized by the occurrence of kinematic loops. In particular, the interaction between large rigid body motions and small elastic deformations are taken into account. A computer program is developed and test calculations are being performed in several spacecraft systems. ESA

N92-24390# Ruhr Univ., Bochum (Germany, F.R.). Astronomisches Inst.
THE HEXA-POD TELESCOPE WITH DIGITAL IMAGE PROCESSING: SUPERTELESCOPE REQUIRES NEW IDEAS [HEXA-POD-TELESKOP MIT DIGITALER BILDVERARBEITUNG: SUPERTELESKOP ERFORDERT NEUE IDEEN] **c89**
In Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 101-102 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The Hexa-Pod Telescope (HPT) with a radically new mounting concept is being developed. It is planned to be the largest (mirror diameter 12 m) and most efficient optical single telescope in the world. Novel concepts and ideas have to be developed and applied in combination with the newest technologies. The optical structure with mirrors is running on bearings on six legs with adjustable length, resulting in a strong weight reduction and simple mechanical structures. The use of carbon fiber reinforced plastics allows a suitable choice of thermal expansion coefficients, while the use of laser gyroscopes provides very accurate angle measurements. The main advantages of the HPT are low weight and high surface precision. ESA

N92-24391# Ruhr Univ., Bochum (Germany, F.R.). Lehrstuhl Werkstoffwissenschaft.
DEVELOPMENT OF A CLAW ELEMENT MODE OF SHAPE MEMORY COMPOSITES [ENTWICKLUNG EINES GREIFELEMENTES AUS FORMGEDAECHTNIS-VERBUNDWERKSTOFF] **c24**
E. Hornbogen *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 103-104 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

A composite consisting of a shape memory deposit and an elastomer matrix is being developed for an actuator or claw element. Shape memory alloys can change their macroscopic form during heating or coding. The research program comprises the production and performance testing of the alloys. ESA

N92-24392# Gesamthochschule, Essen (Germany, F.R.). Lehrstuhl fuer Stroemungslehre.
INTERACTION BETWEEN SHOCK WAVE AND TUBULAR FLOW [WECHSELWIRKUNG ZWISCHEN EINER STOSSWELLE UND EINER TURBULENTEN STROEMUNG] **c34**
W. Merzkirch *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 107 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The interaction between a shock wave and a compressible turbulent flow is investigated in a shock tube using laser speckle photography. The aim is to determine how the characteristics of the turbulent flow can be changed due to the compression by the shock wave, with a view to the aerodynamics of spacecrafts on which turbulent boundary layers develop. Preliminary results show an enhancement of the turbulence intensity by an order of magnitude in the range of low wave numbers, while the higher turbulence frequencies intensities do not seem to be enhanced. ESA

N92-24393# Technische Hochschule, Aachen (Germany, F.R.). Inst. fuer Geometrie und Praktische.
SIMULATION OF THE FLOW ON A SPACE GLIDER. STAGNATION POINT CALCULATION USING THE 2D NAVIER-STOKES EQUATIONS INCLUDING CHEMICAL EFFECTS [STROEMUNGSSIMULATION AN EINEM RAUMGLEITER. STAUPUNKTBERECHNUNG MITTELS DER 2D-NAVIER-STOKES-GLEICHUNGEN MIT CHEMIE] **c02**
S. Mueller *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 109-110 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The flow at the nose of space gliders is numerically simulated. In a first phase only friction force, heat conduction, and diffusion are taken into account (Navier-Stokes equations). In the second phase, chemical effects such as dissociation and ionization are taken into account since at high Mach numbers very high temperatures occur. The one dimensional so-called ENO numerical simulation procedure is integrated in a two dimensional finite volume method. Friction force, diffusion, and heat conduction are approximated using a special interpolation technique. The chemical reactions are built in by an operator splitting. ESA

N92-24394# Technische Hochschule, Aachen (Germany, F.R.). Lehr- und Forschungsgebiet fuer Mechanik.
HYPERSONIC CONFIGURATIONS IN SLOW SPEED FLIGHT [HYPERSONISCHE KONFIGURATIONEN IM LANGSAMFLUG] **c02**
C.-A. Mueller *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 111-112 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

Theoretical methods for inviscid and compressible, stationary subsonic flows about hypersonic flight configurations are developed with a view to the design of such configurations. These are reliable numerical methods for the boundary layer calculation, for the prediction of flow separation, for the simulation of the produced free vortices, as well as for the prediction of the global aerodynamic behavior of the configuration. ESA

N92-24395# Technische Hochschule, Aachen (Germany, F.R.). Lehr- und Forschungsgebiet fuer Mechanik.
SUPERSONIC FLOW IN COMPRESSION STAGES AND INLETS [UEBERSCHALLSTROEMUNGEN IN VERDICHTERSTUFEN UND EINLAEUFEN] **c02**
I. Grotowsky *In* Minister fuer Wissenschaft und Forschung des Landes Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 113-114 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

Characteristic oriented calculation methods are developed for supersonic flows in compressors and inlet diffusers. The aim is to obtain design hints for the integration of inlets in hypersonic configurations and for channel geometries with possibly low loss delay of the supersonic flow in compressors and inlets using oblique shock systems. The high thermal loading in the corners of the inlet channels has to be analyzed and improved. A numerical bicharacteristics method for compressor with axial supersonic flow gives good approximate results, although for the calculation of multishock systems Godunov type procedures have to be used. ESA

N92-24396# Deutsche Agentur fuer Raumfahrtangelegenheiten G.m.b.H., Bonn (Germany, F.R.).
DARA: THE GERMAN SPACE AGENCY [DARA: DIE DEUTSCHE AGENTUR FUER RAUMFAHRTANGELEGENHEITEN GMBH] **c81**
In Minister fuer Wissenschaft und Forschung des Landes

Nordrhein-Westfalen, Subject Space 2: A Documentation on Space Research in North-Rhineland-Westphalia in the Period 1985-1990 Dec. 1990 p 117-119 In GERMAN (For primary document see N92-24351 15-99)
Avail: NTIS HC/MF A08

The German Agency for Space Flight Affairs (DARA) is responsible for the establishment and realization of the German Space Program planning, and has to take care of the German interests in the international space programs. The different aspects of these tasks are described. ESA

N92-24806*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LDEF: 69 MONTHS IN SPACE. FIRST POST-RETRIEVAL SYMPOSIUM, PART 2
Arlene S. Levine, ed. Jan. 1992 588 p Symposium held in Kissimmee, FL, 2-8 Jun. 1991; sponsored by NASA, Washington Original contains color illustrations
(NASA-CP-3134-Pt-2; L-17042-Pt-2; NAS 1.55:3134-Pt-2) Avail: NTIS HC/MF A25; 2 functional color pages CSCL 07D

A compilation of papers from the symposium is presented. The preliminary data analysis is presented of the 57 experiments flown on the LDEF. The experiments include materials, coatings, thermal systems, power and propulsion, science (cosmic ray, interstellar gas, heavy ions, and micrometeoroid), electronics, optics, and life science. For individual titles, see N92-24807 through N92-24846.

N92-24807*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
PRELIMINARY FINDINGS OF THE LDEF MATERIALS SPECIAL INVESTIGATION GROUP **c18**
Bland A. Stein and H. Gary Pippin (Boeing Co., Seattle, WA.) *In its* LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 617-641 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 22B

The retrieval of NASA's LDEF from low Earth orbit provided an opportunity for the study of long duration space environmental effects on materials. The five year, nine month flight of the LDEF greatly enhanced the potential value of most LDEF materials. NASA recognized this potential by forming the LDEF Space Environmental Effects on Materials Special Investigation Group (MSIG). Its goal is to explore the expanded materials analysis opportunities available in the LDEF structure and on experiment trays. The charter and scope of MSIG activities is presented, followed by an overview of the preliminary MSIG observations. These observations of low Earth orbit environmental effects on materials were made in-space during LDEF retrieval and during LDEF tray disintegration. Also presented are initial findings of lab analyses of LDEF materials. Included are effects of individual environmental parameters: atomic oxygen, ultraviolet radiation, meteoroid and debris impacts, thermal cycling, vacuum, and contamination, plus combined effects of these parameters. Materials considered include anodized aluminum, polymer matrix composites, polymer films, silvered Teflon thermal blankets, and a white thermal control paint. Author

N92-24808*# Boeing Co., Seattle, WA. Defense and Space Group.
ATOMIC OXYGEN AND ULTRAVIOLET RADIATION MISSION TOTAL EXPOSURES FOR LDEF EXPERIMENTS **c72**
R. J. Bourassa, J. R. Gillis, and Ken W. Rousslang (Puget Sound Univ., Tacoma, WA.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 643-661 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 20H

Atomic oxygen and solar radiation exposures were determined analytically for rows, longerons, and end bays of the LDEF. Calculated atomic oxygen exposures are based on an analytical model that accounts for the effects of thermal molecular velocity, atmospheric temperature, number density, spacecraft velocity, incidence angle, and atmospheric rotation. Results also incorporate variations in solar activity, geomagnetic index, and orbital parameters occurring over the six year flight of the spacecraft. Solar radiation exposure calculations are based on the form factors reported in the Solar Illumination Data Package prepared by NASA Langley. The earth albedo value for these calculations was based on the Nimbus 7 earth radiation data set. Summary charts for both atomic oxygen and solar radiation exposure are presented to facilitate the use of the data generated by LDEF experimenters. Author

N92-24809*# Phillips Lab., Kirkland AFB, NM.
EFFECTS OF SPACE ENVIRONMENT ON STRUCTURAL MATERIALS **c25**
C. Miglionico, C. Stein, R. Roybal, R. Robertson, L. E. Murr, S. Quinones, J. Rivas, B. Marquez, A. H. Advani, and W. W. Fisher (Texas Univ., El Paso.) et al *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 663-677 (For primary document see N92-24806 15-99)
(Grant NAG9-481)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 07D

A preliminary study of materials exposed in space in a low Earth orbit for nearly six years has revealed a wide range of micrometeorite or microparticle impact craters ranging in size from 1 to 1000 micron in diameter, debris particles from adjacent and distant materials systems, reaction products, and other growth features on the specimen surfaces, and related phenomena. The exposed surface features included fine grained and nearly amorphous materials as well as a large array of single crystal particles. A replication type, lift off technique was developed to remove reaction products and debris from the specimen surfaces in order to isolate them from the background substrate without creating microchemical or microstructural artifacts or alterations. This resulted in surface features resting on a carbon support film which was virtually invisible to observation by electron microscopy and nondispersive x ray analysis. Some evidence for blisters on leading edge aluminum alloy surfaces and a high surface region concentration of oxygen determined by Auger electron spectrometry suggests oxygen effects where fluences exceed 10(exp 21) atoms/sq cm. Author

N92-24810*# Army Materials Technology Lab., Watertown, MA.
MEASUREMENT OF THE O-18 TO O-16 ISOTOPE RATIO FOR CHARACTERIZING OXIDE SURFACE LAYERS ON LDEF SAMPLES **c72**
Paul L. Sagalyn *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 679-686 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 20H

The ratio of the density of the oxygen 18 isotope (O-18) to the density of the oxygen 16 isotope (O-16) is a strong function of altitude in the atmosphere because of the stronger gravitational attraction on the heavier isotope. It is proposed that the measurement of this ratio for oxide surface layers on LDEF samples can easily distinguish oxides formed in orbit from contaminative oxides formed during retrieval procedures. Since the satellite altitude is known as a function of time, it may be possible to use the measured ratio to determine the time of formation of oxide layers, the accuracy depending upon the stability of the atmosphere. Author

N92-24811*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
CHEMICAL CHARACTERIZATION OF SELECTED LDEF POLYMERIC MATERIALS **c27**
Philip R. Young and Wayne S. Slemp *In its* LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 687-703 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

The chemical characterization of selected polymeric materials which received exposure on the LDEF is reported. The specimens

examined include silvered fluorinated ethylene propylene (FEP) teflon thermal blanket material, polysulfone matrix resin/graphite fiber reinforced composites, and several high performance polymer films. These specimens came from numerous LDEF locations and, thus, received different environmental exposures. The results of infrared, thermal, x ray photoelectron, and various solution property analyses have shown no significant change at the molecular level in the polymer that survived exposure. However, scanning electron and scanning tunneling microscopies show resin loss and a texturing of the surface of some specimens which resulted in a change in optical properties. The potential effect of a silicon containing molecular contamination on these materials is addressed. The possibility of continued post-exposure degradation of some polymeric films is also proposed. Author

N92-24812*# Texas A&M Univ., College Station. Polymer Science and Engineering Program.

CHARACTERIZATION OF POLYMER FILMS RETRIEVED FROM LDEF c27

Alan Letton, Neil I. Rock, Kevin D. Williams, Thomas W. Strganac, and Allan Farrow *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 705-722 Sponsored in part by Rheometrics, Inc. (For primary document see N92-24806 15-99)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

One of the trays aboard LDEF was an experiment having the objective of assessing the effects of long term exposure of candidate balloon films, tapes, and lines to the hostile environment of space. The fortuitous location of these materials on LDEF minimized direct impact by atomic oxygen thus providing an opportunity to study the effects of low earth orbit environments on polymeric materials without the worry of atomic oxygen abrasion. The resulting chemical, morphological, and thermomechanical changes for polyethylene specimens are reviewed. In addition, preliminary data for fluorinated ethylene/propylene copolymers used for thermal blankets is presented. Polyethylene is observed to crosslink and branch from exposure to atomic oxygen and/or ultraviolet with a decrease in crystallinity. Author

N92-24813*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

MEASUREMENTS OF EROSION CHARACTERISTICS FOR METAL AND POLYMER SURFACES USING PROFILOMETRY c27

Ligia C. Christl, John C. Gregory (Alabama Univ., Huntsville.), and Palmer N. Peters *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 723-735 (For primary document see N92-24806 15-99)

(Contract NAS8-36645; NAGw-812)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

The surfaces of many materials exposed in low earth orbit are modified due to interaction with atomic oxygen. Chemical changes and surface roughening effects can occur which alter optical and other properties. The experiment A0114 contained 128 solid surface samples, half of which were exposed on the front and half on the rear of LDEF. Each sample has been subjected to many analyses, but only the methods and techniques used to measure the changes in roughness, erosion depths, and material growth using profilometry are described. Author

N92-24814*# TRW Space and Defense Sector, Redondo Beach, CA.

LONG DURATION EXPOSURE FACILITY (LDEF) PRELIMINARY FINDINGS: LEO SPACE EFFECTS ON THE SPACE PLASMA-VOLTAGE DRAINAGE EXPERIMENT c33

Brian K. Blakkolb, James Y. Yaung, Kelly A. Henderson, William W. Taylor, and Lorraine E. Ryan *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 737-752 (For primary document see N92-24806 15-99)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 09A

The Space Plasma-High Voltage Drainage Experiment (SP-HVDE) provided a unique opportunity to study long term space environmental effects on materials because it was comprised of two identical experimental trays; one tray located on the ram facing side (D-10), and the other on the wake facing side (B-4) of the LDEF. This configuration allows for the comparison of identical materials exposed to two distinctly different environments. The purpose of this work is to document an assessment of the effects of five and three quarters years of low Earth orbital space exposure on materials comprising the SP-HVDE (experiment no. A0054). The findings of the materials investigation reported focus on atomic oxygen effects, micrometeor and debris impact site documentation, thermal property measurements, and environmentally induced contamination. Author

N92-24815*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

INTERACTIONS OF ATOMIC OXYGEN WITH MATERIAL SURFACES IN LOW EARTH ORBIT: PRELIMINARY RESULTS FROM EXPERIMENT A0114 Abstract Only c72

John C. Gregory, Ligia C. Christl, Ganesh N. Raikar, J. J. Weimer, R. Wiser (Alabama Univ., Huntsville.), and Palmer N. Peters *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 753 (For primary document see N92-24806 15-99)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 20H

The atomic oxygen experiment consisted of two trays (one-sixth of a Long Duration Exposure Facility (LDEF) tray each) of 64 one inch diameter solid samples. It was intended that the effects of atomic oxygen and solar ultraviolet irradiation on the surface properties of each material could be distinguished from each other and from the effects of aging. Sixteen of the samples were placed on a thermally isolated plate of highly polished aluminum, while the main plate was coated with the thermal control coating S13-GLO. Though the experiment was entirely passive, it was hoped that the effects of thermal activation might be observed, if present. The plates were expected to stabilize at temperatures differing by 20-30 C. The samples included thin films of metals Os, Ir, Pt, Ni, Mo, and Al coated onto silica optical flats, metal carbides (WC, SiC), solid carbons of various types, eight polymers, and some other coatings of various types. Analysis is essentially complete using stylus profilometry with high sensitivity Talystep and lower sensitivity Talysurf machines. Though the integrated fluence of O atoms on the LDEF was 30 times that of previous missions, etch depths of the polymers such as the polyimide Kapton show excellent agreement with extrapolations from previous flight data. However, some new effects were observed. We demonstrated on a previous experiment on STS-8 that profilometry of this kind can show steps of 50 A (for example those due to oxide film growth on metals) and this is now the preferred method for estimating etch depth (or mass loss) of erodible substances.

Author

N92-24816*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

EFFECTS ON LDEF EXPOSED COPPER FILM AND BULK c26

Palmer N. Peters, John C. Gregory, Ligia C. Christl, and Ganesh N. Raikar (Alabama Univ., Huntsville.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 755-762 (For primary document see N92-24806 15-99)

(Contract NAS8-36645; NAGw-812)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11F

Two forms of copper were exposed to the Long Duration Exposure Facility (LDEF) Mission 1 environment: a copper film initially 74.2 plus or minus 1.1 nm thick sputter coated on a fused silical flat and a bulk piece of oxygen free, high conductivity (OFHC) copper. The optical density of the copper film changed from 1.33 to 0.70 where exposed and the film thickness increased to 106.7 plus or minus 0.5 nm where exposed. The exposed area appears purple by reflection and green by transmission for the thin film and maroon color for the bulk copper piece. The exposed areas increased in thickness, but only increase in the thickness of thin film samples could be readily measured. The increase in film

thickness is consistent with the density changes occurring during conversion of copper to an oxide. However, we have not been able to confirm appreciable conversion to an oxide by x ray diffraction studies. We have not yet subjected the sample to e-beams or more abusive conditions out of concern that the film might be modified. Author

N92-24817*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

LDEF EXPERIMENT A0034: ATOMIC OXYGEN STIMULATED OUTGASSING **c72**

Roger C. Linton, Rachel R. Kamenetzky, John M. Reynolds, and Charles L. Burris (Southern Univ., Baton Rouge, LA.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 763-779 (For primary document see N92-24806 15-99)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 20H

The passive Long Duration Exposure Facility (LDEF) Experiment A0034, 'Atomic Oxygen Stimulated Outgassing', consisted of two identical one-sixth tray modules, exposing selected thermal control coatings to atomic oxygen and the combined space environment on the leading edge, and for reference, to the relative 'wake' environment of the trailing edge. Optical mirrors were included adjacent to the thermal coatings for deposition of the outgassing products. Ultraviolet grade windows and metal covers were provided for additional assessment of the effects of various environmental factors. Preliminary results indicate that orbital atomic oxygen is both a degrading and optically restorative factor in the thermo-optical properties of selected thermal coatings. There is evidence of more severe optical degradation on collector mirrors adjacent to coatings that were exposed to RAM-impinging atomic oxygen. This evidence of atomic oxygen stimulated outgassing is discussed in relation to alternative factors that could affect degradation. The general effects of the space environment on the experiment hardware as well as the specimens are discussed. Author

N92-24818*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ATOMIC OXYGEN UNDERCUTTING OF LDEF ALUMINIZED-KAPTON MULTILAYER INSULATION **c72**

Kim K. deGroh and Bruce A. Banks *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 781-795 (For primary document see N92-24806 15-99)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 20H

Atomic oxygen undercutting is a potential threat to vulnerable spacecraft materials which have atomic oxygen protective coatings. Such undercutting is due to atomic oxygen attack of oxidizable materials at microscopic defects in the protective coatings. These defects occur during fabrication and handling, or from micrometeoroid and debris bombardment in space. An aluminized-polyimide Kapton multilayer insulation sample that was located on the leading edge of the Long Duration Exposure Facility (LDEF) was used to study low Earth orbit directed ram atomic oxygen undercutting. Cracks in the aluminized coatings located around vent holes provided excellent defect sites for evaluation of atomic oxygen undercutting. The experimentally observed undercutting profiles were compared to predictions from Monte Carlo models for normal incident ram atomic oxygen attack. The shape of the undercut profile was found to vary with crack width, which is proportional to the number of oxygen atoms entering the crack. The resulting profiles of atomic oxygen which occurred on LDEF indicated wide undercut cavities in spite of the fixed ram orientation. Potential causes of the observed undercutting are presented. Implications of the undercutting profiles relevant to the Space Station Freedom are also discussed. Author

N92-24819*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

PRELIMINARY RESULTS FOR LDEF/HEPP THERMAL CONTROL SAMPLES **c27**

Lonny Kauder *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 797-800 (For primary document see N92-24806 15-99)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

Specimens of Kapton coated with black paint, white paint, and thin film oxides were flown at three locations aboard the Long Duration Exposure Facility (LDEF) to evaluate their resistance to atomic oxygen erosion. Post flight emittance and solar absorptance measurements are compared with pre-flight values. Author

N92-24820*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

ATOMIC OXYGEN INTERACTIONS WITH FEP TEFLON AND SILICONES ON LDEF **c27**

Bruce A. Banks, Joyce A. Dever, Linda Gebauer, and Carol M. Hill (Akron Univ., OH.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 801-815 (For primary document see N92-24806 15-99)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

The Long Duration Exposure Facility (LDEF) spacecraft has enabled the measurement of the effects of fixed orientation exposure of high fluence atomic oxygen on fluorinated ethylene propylene (FEP Teflon) and silicones. The atomic oxygen erosion yield for the FEP Teflon was found to be 3.64 x 10(exp -25) cm(exp 3)/atom. This erosion yield is significantly higher than that measured from previous low fluence orbital data. The FEP Teflon erosion yield was found to have the same dependence on oxygen arrival angle as Kapton and Mylar. Atomic oxygen interaction with silicon polymers results in the crazing of silicon. Released silicone contaminants were found to darken upon further atomic oxygen exposure. Author

N92-24821*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

VACUUM ULTRAVIOLET (VUV) RADIATION-INDUCED DEGRADATION OF FLUORINATED ETHYLENE PROPYLENE (FEP) TEFLON ABOARD THE LONG DURATION EXPOSURE FACILITY (LDEF) **c27**

David E. Brinza, A. E. Stiegman, Paul R. Staszak, Eric G. Laue, and Ranty H. Liang *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 817-829 (For primary document see N92-24806 15-99)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

Examination of fluorinated ethylene propylene (FEP) copolymer specimens recovered from the Long Duration Exposure Facility (LDEF) provides evidence for degradation attributed to extended solar vacuum ultraviolet (VUV) irradiation. Scanning electron microscope (SEM) images of sheared FEP film edges reveal the presence of a highly embrittled layer on the exposed surface of specimens obtained from the trailing edge of the LDEF. Similar images obtained for leading edge and control FEP films do not exhibit evidence for such an embrittled layer. Laboratory VUV irradiation of FEP films is found to produce a damage layer similar to that witnessed in the LDEF trailing edge films. Spectroscopic analyses of irradiated films provide data to advance a photochemical mechanism for degradation. Author

N92-24822*# Aerospace Corp., El Segundo, CA.

SPACE ENVIRONMENTAL EFFECTS ON SILVERED TEFLON THERMAL CONTROL SURFACES **c27**

C. S. Hemminger, W. K. Stuckey, and J. C. Uht *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 831-845 (For primary document see N92-24806 15-99)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

Cumulative space environmental effects on silver/fluorinated ethylene propylene (Ag/FEP) were a function of exposure orientation. Samples from nineteen silvered Teflon (Ag/FEP) thermal control surfaces recovered from the Long Duration Exposure Facility (LDEF) were analyzed to determine changes in this material as a function of position on the spacecraft. Although

solar absorptance and infrared emittance of measured thermal blanket specimens are relatively unchanged from control specimen values, significant changes in surface morphology, composition, and chemistry were observed. We hypothesize that the FEP surfaces on the LDEF are degraded by UV radiation at all orientations, but that the damaged material has been removed by erosion from the blankets exposed to atomic oxygen flux and that contamination is masking the damage in some areas on the trays flanking the trailing edge. Author

N92-24823*# Boeing Aerospace and Electronics Co., Seattle, WA.
RESULTS OF EXAMINATION OF SILVERED TEFLON FROM THE LONG DURATION EXPOSURE FACILITY c27
Ken Rousslang, E. Russ Crutcher, and H. Gary Pippin *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 847-859 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

A significant effort to determine the effects of low earth orbit (LEO) exposure on silver backed fluorinated ethylene-propylene (FEP) blankets from the Long Duration Exposure Facility (LDEF) was performed, and the results of this investigation are described. Extensive measurements of surface, optical, chemical, and mechanical properties were conducted. Effects of contamination and erosion rates of the FEP layer were determined. Specific results are reported on solar absorptance, thermal emittance, diffuse reflectance, cross sectional microphotography, secondary ion mass spectroscopy, electron scattering for chemical analysis, scanning electron microscopy, percent elongation, and tensile strength. These measurements show the effects of two distinctly different exposure environments, solar exposure, and simultaneous atomic oxygen (AO) and solar exposure. Author

N92-24824*# Boeing Co., Seattle, WA. Defence and Space Group.
SILVER TEFLON BLANKET: LDEF TRAY C-08 c27
E. Russ Crutcher, L. S. Nishimura, K. J. Warner, and W. W. Wascher *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 861-874 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

A study of the Teflon blanket surface at the edge of tray C-08 illustrates the complexity of the microenvironments on the Long Duration Exposure Facility (LDEF). The distribution of particulate contaminants varied dramatically over a distance of half a centimeter (quarter of an inch) near the edge of the blanket. The geometry and optical effects of the atomic oxygen erosion varied significantly over the few centimeters where the blanket folded over the edge of the tray resulting in a variety of orientations to the atomic oxygen flux. A very complex region of combined mechanical and atomic oxygen damage occurred where the blanket contacted the edge of the tray. A brown film deposit apparently fixed by ultraviolet light traveling by reflection through the Teflon film was conspicuous beyond the tray contract zone. Chemical and structural analysis of the surface of the brown film and beyond toward the protected edge of the blanket indicated some penetration of energetic atomic oxygen at least five millimeters past the blanket-tray contact interface. Author

N92-24825*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
PRELIMINARY INVESTIGATIONS INTO UHCRE THERMAL CONTROL MATERIALS (A0178) c27
Francois Levadou, Mike Froggatt, Martin Rott, and Eberhard Schneider (Ernst-Mach-Inst., Freiburg, Germany, F.R.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 875-898 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

An overview of the initial work that was done in the ESTEC Materials and Processes Division to evaluate the effect of space environment on the thermal blankets of the Ultra-Heavy Cosmic Ray Nuclei Experiments (UHCRE) is presented. The topics covered include: (1) a preliminary survey of the perforations of the two-thirds of the thermal blanket returned to ESTEC; (2) thermo-optical properties and thickness recessions of three samples cut from each of the third center parts of the 16 thermal blankets were measured and effects of environments (sun illumination and atomic oxygen fluences); (3) contamination was analyzed on trays, external blanket and internal aluminized Kapton foil by IR technique and scanning electron microscopy SEM/EDX examination; (4) the pattern of contamination on the Al Kapton foils was observed, sketched, and related to atomic oxygen flow; and (5) the Long Duration Exposure Facility (LDEF) yaw angle misorientation was evaluated from the contaminated areas visible on some of the trays. In addition, impacts of micrometeoroids and space debris were experimentally simulated on spare flight thermal blankets. Relations between penetration/perforation hole characteristics and projectile parameters were established. Author

N92-24826*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
INITIAL MATERIALS EVALUATION OF THE THERMAL CONTROL SURFACES EXPERIMENT (S0069) c27
Donald R. Wilkes, M. John Brown, Leigh L. Hummer (AZ Technology, Huntsville, AL.), and James M. Zwiener *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 899-917 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

The Thermal Control Surface Experiment (TCSE) was flown on the NASA Long Duration Exposure Facility (LDEF) with the basic objective of determining the effects of the near-earth orbital environment and the LDEF induced environment on spacecraft thermal control surfaces. The TCSE was a comprehensive experiment that combined in-space measurements with extensive post-flight analyses of thermal control surfaces to determine the effects of exposure to the low earth orbit space environment. The TCSE is the first space experiment to measure the optical properties of thermal control surfaces the way they are routinely measured in the laboratory. The specific mission objectives of the TCSE were to: (1) determine the effects of the natural and induced space environment on thermal control surfaces; (2) provide in-space performance data on thermal control surfaces; (3) provide in-space comparison to ground-based environmental testing of materials; and (4) develop and prove instrumentation to perform in-space optical testing of materials. Various aspects of the experiment are discussed. K.S.

N92-24827*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
UNUSUAL MATERIALS EFFECTS OBSERVED ON THE THERMAL CONTROL SURFACES EXPERIMENT (S0069) c27
James M. Zwiener, Kenneth A. Herren, Donald R. Wilkes, Leigh L. Hummer, and Edgar R. Miller (AZ Technology, Huntsville, AL.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 919-933 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

A number of unusual effects were observed on the Thermal Control Surfaces Experiment (TCSE) test samples, front cover, and structural components. These effects include atomic oxygen (AO) texturing of the exposed surface of the silver Teflon (Ag/FEP) thermal control material, 'brownish' discoloration of the Ag/FEP material, changes in fluorescence of thermal control paint samples, and meteoroid/debris impact effects on silver Teflon. Author

N92-24828*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EFFECTS OF LOW EARTH ORBIT ENVIRONMENT ON THE LONG DURATION EXPOSURE FACILITY THERMAL CONTROL COATINGS c27

Thomas R. Sampair (Lockheed Engineering and Sciences Co., Hampton, VA.) and William M. Berrios *In its* LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 935-944 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

One of the benefits of the Long Duration Exposure Facility (LDEF) was the opportunity to study the before and after effects of low earth orbit space environment on the spacecraft thermal control coatings. Since the LDEF's thermal control was totally passive by design, the selection of the external surface absorptivity to emissivity ratio (alpha/epsilon) and the ability for the coating to retain the alpha/epsilon over time was an important consideration in the thermal design of the LDEF. The primary surface coating chosen for the LDEF structure was clear chromic anodized aluminum with an average design alpha/epsilon of 0.32/0.16. External surface absorptivity (alpha) and emissivity (epsilon) were measured on all intercostals, longerons, tray mounting flanges, thermal control panels, and a limited number of experiment surface coatings after the experiment trays were removed from the LDEF structure. All surface alpha/epsilon measurements were made using portable hand held infrared and solar spectrum reflectometers. The absorptivity measurements were taken with a Devices and Services SSR-ER version 5.0 solar spectra reflectometer which has a stated uncertainty of +/- 0.01, and all normal emissivity measurements were made using the Gier Dunkle DB-100 infrared reflectometer also with a stated uncertainty of +/- 0.01. Both instruments were calibrated in the laboratory by LaRC instrumentation personnel before being used in the field at KSC. A combined total of 733 measurements were taken on the anodized aluminum hardware which included the structure (intercostals, longerons, and center ring), earth and space end thermal control panels, and experiment tray mounting flanges. The facility thermal control coatings measured in this survey cover 33 percent of the total exposed LDEF surface area. To correlate low earth orbit environmental effects on the anodized coatings, measurements were taken in both exposed and unexposed surfaces and compared to quality assurance (QA) measurements taken on the new surfaces at the time of hardware fabrication in 1978. The results of investigation are presented. Author

N92-24829*# Centre National d'Etudes Spatiales, Toulouse (France).
SPACECRAFT THERMAL CONTROL COATINGS **c27**
Jean-Claude Guillaumon and Alain Paillous (Centre d'Etudes et de Recherches, Toulouse, France) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 945-960 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

The Experiment AO 138-6 was located on the trailing edge of the Long Duration Exposure Facility as part of the French Cooperative Payload (FRECOPA) Experiment. It was purely passive in nature: material specimens 2 x 2 cm, independently mounted in sample-holders, with their surface in the same reference plane, were exposed to space. Thirty samples were set in a vacuum-tight canister which was opened in space a few days after LDEF deployment and closed while still in orbit ten months later; twenty-four samples were directly exposed to space for the total flight duration (preflight handling, shuttle bay environment, separation from shuttle, shuttle environment, LEO environment, docking, descent, transfer to KSC). Materials included paints (conductive or nonconductive), SSM's, polymeric films, surface coatings, composite materials, and metals. After sample retrieving, inspection and measurements were carried out in atmospheric laboratory conditions on each sample: observation with binocular lenses and scanning electron microscopy, spectral relectance and transmittance using an integrating sphere in the wavelength range 280-2300 nm, emissivity by the means of a Gier & Dunkle portable reflectometer, electron spectroscopy for chemical analysis-x-ray photoelectron spectroscopy (ESCA-XPS), and Rutherford backscattering spectroscopy (RBS) measurements on some selected samples. The results obtained from flight were compared to laboratory data obtained in UV-irradiation tests when these data were available. As a general statement a good spectral concordance is observed for all samples not in the canister so long as air recoveries are taken into account. For one material, the degradation is more important for the sample in the canister than for those of the same material mounted at the surface of the tray; for most samples in the canister the degradation is slightly higher than the one which can be predicted from laboratory standard irradiations. Contamination problems having been ruled out, the higher temperature experience by the samples on the inside of canister probably explains these phenomena. Author

N92-24830*# Dayton Univ. Research Inst., OH.
LONG DURATION EXPOSURE FACILITY EXPERIMENT M0003-5: THERMAL CONTROL MATERIALS **c27**
Charles J. Hurley *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 961-973 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

The Long Duration Exposure Facility M0003-5 Thermal Control Materials Experiment contained numerous thermal control coatings, metallized and nonmetallized polymeric films, adhesives, optical solar reflectors, and metallic foils. The materials were located on the leading and trailing edges of the satellite; therefore, therefore exposed to two different low earth orbital environments. Many specimens received total exposure periods of 0.9 years and 5.75 years respectively. A small selection of the total number of flight specimens are visually exhibited. The material's physical and optical performance are summarized as a function of location and duration of exposure. Comments concerning specimen condition, degradation, contamination, optical reflectance, and transmittance are provided. Author

N92-24831*# Boeing Co., Seattle, WA. Defense and Space Group.
RESULTS OF EXAMINATION OF THE A276 WHITE AND Z306 BLACK THERMAL CONTROL PAINT DISKS FLOWN ON LDEF **c27**
Johnny L. Golden *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 975-987 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

Specimens of A276 white and Z306 black thermal control paints were analyzed for the effects of space environmental exposure as part of the Long Duration Exposure Facility (LDEF) Materials Special Investigation Group activity. The specimens, actually disks or spots of paint on tray clamps, were located at regular intervals on all LDEF longerons and intercostals. The principle conclusions from the analysis are: UV exposure degraded the surface resin of A276 paint, with coating solar absorptance increasing with UV exposure; contamination, though detected, was not enough to have adversely affected optical properties; atomic oxygen eroded resin on specimens with incidence angles of up to 100 deg; the erosion of Z306 paint on leading edge specimens removed a minimum of 10 microns of that coating; and the erosion of A276 paint at up to 80 deg incidence angle resulted in near original condition solar absorptance readings. D.R.D.

N92-24832*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ION BEAM TEXTURED AND COATED SURFACES EXPERIMENT (IBEX) **c27**
Michael J. Mirtich, Sharon K. Rutledge, Nicholas Stevens, Raymond Olle, and James Merrow (Cleveland State Univ., OH.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 989-1004 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

Ion beam textured and commercial materials suitable for use in space power systems were flown in low Earth orbit on the Long Duration Exposure Facility (LDEF) for 5.8 years. Because of

their location on LDEF (98 deg from the ram direction), the 36 materials were primarily exposed to vacuum ultraviolet radiation, thermal cycling, the vacuum of space, the micrometeoroid environment, and grazing incidence atomic oxygen. Measurements of solar absorptance and thermal emittance (pre- and post-flight) showed no changes for almost all of the materials, except for the S-13G and Kapton and coated Kapton samples. The optical property stability of ion beam textured surfaces and most other surfaces indicates that they are functionally durable to the synergistic rigors of the space environment. D.R.D.

N92-24833*# Army Materials Technology Lab., Watertown, MA.
ELLIPSOMETRIC STUDY OF OXIDE FILMS FORMED ON LDEF METAL SAMPLES **c27**
W. Franzen, J. S. Brodkin, L. C. Sengupta, and P. L. Sagalyn *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1005-1021 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

The optical constants of samples of six different metals (Al, Cu, Ni, Ta, W, and Zr) exposed to space on the Long Duration Exposure Facility (LDEF) were studied by variable angle spectroscopic ellipsometry. Measurements were also carried out on portions of each sample which were shielded from direct exposure by a metal bar. A least-squares fit of the data using an effective medium approximation was then carried out, with thickness and composition of surface films formed on the metal substrates as variable parameters. The analysis revealed that exposed portions of the Cu, Ni, Ta, and Zr samples are covered with porous oxide films ranging in thickness from 500 to 1000 A. The 410 A thick film of Al2O3 on the exposed Al sample is practically free of voids. Except for Cu, the shielded portions of these metals are covered by thin non-porous oxide films characteristic of exposure to air. The shielded part of the Cu sample has a much thicker porous coating of Cu2O. The tungsten data could not be analyzed. D.R.D.

N92-24834*# Boeing Co., Seattle, WA. Defense and Space Group.
SPACE ENVIRONMENTAL EFFECTS ON THE INTEGRITY OF CHROMIC ACID ANODIZED COATINGS **c27**
Walter L. Plagemann *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1023-1040 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

The Long Duration Exposure Facility (LDEF) tray clamps used to hold the experiment trays in place on the LDEF were analyzed to determine the effects of long term space exposure on the performance of the chromic acid anodized coating. Spectroscopic anomalies observed appeared to be random and related to application techniques as opposed to exposure or position on LDEF. Thickness measurements indicated that the coating was less than 1u and was probably not degraded by space exposure. Metallurgical analysis revealed that leading edge exposure may have increased the porosity of the coating. Emittance values for the coating decreased uniformly by an average of 6.8 percent while solar absorptance values increased for trailing edge and decreased for leading edge specimens. The a/e ratio for the coating also increased as a result of long term space exposure. Author

N92-24835*# Aerospace Corp., El Segundo, CA.
M0003-10: LDEF ADVANCED COMPOSITES EXPERIMENT **c24**
Gary L. Steckel and Tuyen D. Le *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1041-1053 (For primary document see N92-24806 15-99)
(Contract F04701-88-C-0089)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

The Advanced Composites Experiment includes nearly 500 samples of metal matrix, organic matrix, and glass matrix composites that were flown on the leading and trailing edges of the Long Duration Exposure Facility (LDEF). The experiment is a cooperative effort with participation by several aerospace companies. This paper is a review of the preliminary observations and test results. Estimated recession rates from atomic oxygen exposure for organic matrix composites are reported. Preliminary scanning electron microscopy observations for organic and metal matrix composites and microstructural analyses for metal matrix composites are presented. D.R.D.

N92-24836*# Lockheed Missiles and Space Co., Sunnyvale, CA.
LDEF-SPACE ENVIRONMENTAL EFFECTS ON MATERIALS: COMPOSITES AND SILICONE COATINGS Abstract Only **c24**
Brian C. Petrie *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1055 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

The effects of long term low Earth orbit environments on thermal control coatings and organic matrix/fiber reinforced composites are discussed. Two diverse categories are reported here: silicone coatings and composites. For composites physical and structural properties were analyzed; results are reported on mass/dimensional loss, microcracking, short beam shear, coefficient of thermal expansion (CTE), and flexural properties. The changes in thermal control properties, mass, and surface chemistry and morphology are reported and analyzed for the silicone coatings. Author

N92-24837*# Toronto Univ., Downsview (Ontario). Inst. for Aerospace Studies.
PRELIMINARY RESULTS FROM THE LDEF/UTIAS COMPOSITE MATERIALS EXPERIMENT **c24**
R. C. Tennyson, G. E. Mabson, W. D. Morison, and J. Kleiman *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1057-1072 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

A total of 107 epoxy matrix composite samples containing carbon, boron, and aramid fiber reinforcements were flown on the Long Duration Exposure Facility (LDEF) satellite. For the first 371 days after deployment, strain and temperature data were recorded every 16 hours. Results were obtained on time to outgas, dimensional changes, coefficients of thermal expansion, atomic oxygen erosion, and damage due to micrometeoroid/debris impacts. D.R.D.

N92-24838*# Aerospace Corp., El Segundo, CA.
LONG DURATION EXPOSURE FACILITY EXPERIMENT M0003: DEINTEGRATION/FINDINGS AND IMPACTS **c25**
M. J. Meshishnek, S. R. Gyetvay, and C. H. Jaggers *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1073-1107 Sponsored in part by Strategic Defense Initiative Organization and Wright Lab. (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 07D

The Long Duration Exposure Facility (LDEF) Experiment M0003 consists of 19 subexperiments from laboratories and contractor organizations and was designed to study the effects of the space environment on a large variety of spacecraft materials and components, both current and developmental. The experiment was housed in four LDEF trays and contained over 1250 specimens, two data systems, and two environment exposure control canisters. Nearly identical pairs of trays were located on the leading and trailing edges of LDEF. The materials in these trays span nearly all generic functions in spacecraft such as optics, thermal control, composites, solar power, and electronics. Effects of the space environment, such as vacuum, ultraviolet, atomic oxygen, meteoroids and debris, thermal cycling, and synergistic effects on various samples, will be described. Summaries of the on-board data will be presented. Author

N92-24839*# Boeing Co., Seattle, WA. Defense and Space Group.
SURVEY OF RESULTS FROM THE BOEING MODULES ON THE M0003 EXPERIMENT ON LDEF **c25**
H. Gary Pippin, Owen Mulkey, Juris Verzemnieks, Emmett Miller, Sylvester Hill, and Harry Dursch *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1109-1113 Sponsored in part by Wright Lab. (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 07D

The Boeing Company provided specimens to be flown on the Long Duration Exposure Facility (LDEF) as part of the M0003 experiment. This hardware was for the M0003-8 and part of the M003-10 sub-experiments. These specimens were flown on the leading (tray D-9) and trailing (tray D-3) edges, and on trays D-8 (38 degrees from ram) and D-4. Some specimens were mounted in the Experiment Exposure Control Canisters. H.A.

N92-24840*# Boeing Co., Seattle, WA. Defense and Space Group.
RESULTS FROM ANALYSIS OF BOEING COMPOSITE SPECIMENS FLOWN ON LDEF EXPERIMENT M0003 **c24**
Pete E. George and Sylvester G. Hill *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1115-1141 (For primary document see N92-24806 15-99)
(Contract NAS1-18224)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

Specimens of three organic matrix/graphite fiber reinforced composites were flown at both the leading and trailing edge locations on the Long Duration Exposure Facility (LDEF). Selected specimens flown at the trailing edge position were held under tension, compression, and flexure loads for the duration of the flight. Also, two epoxy adhesives with composite and metallic adherends were flown at the trailing edge position. These specimens experienced 5.8 years of exposure to the low earth orbit (LEO) environment where they were subjected to atomic oxygen (AO), thermal cycling, ultraviolet (UV) light, and particulate radiation. Post flight mechanical, chemical, optical, and physical tests were performed and the results were compared to preflight and published values. AO erosion of the leading edge specimens resulted in a significant reduction of mechanical properties and a change in optical properties. Chemical changes occurred only on the surface. Author

N92-24841*# Michigan Univ., Ann Arbor.
HIGH-TOUGHNESS GRAPHITE/EPOXY COMPOSITE MATERIAL EXPERIMENT **c24**
David K. Felbeck *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1143-1147 (For primary document see N92-24806 15-99)
(Contract NAS1-17008)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

This experiment was designed to measure the effect of near space exposure on three mechanical properties of specially toughened 5208/T300 graphite/epoxy composite materials. The properties measured are elastic modulus, strength, and fracture toughness. Six toughness specimens and nine tensile specimens were mounted on an external frame during the time of the Long Duration Exposure Facility (LDEF) mission. Three identical sets of specimens were manufactured at the outset: the flight set, a zero time non-flight set, and a total time non-flight set. To date, two toughness specimens and three strength and modulus specimens have been tested from each of the three groups. Author

N92-24842*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EFFECTS OF LDEF FLIGHT EXPOSURE ON SELECTED POLYMER MATRIX RESIN COMPOSITE MATERIALS **c27**
Wayne S. Slemp, Philip R. Young, William G. Witte, Jr., and James Y. Shen (Lockheed Engineering and Sciences Co., Hampton, VA.) *In its* LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1149-1162 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

The characterization of selected graphite fiber reinforced epoxy (934 and 5208) and polysulfone (P1700) matrix resin composites materials which received over five years and nine months of exposure to the low earth orbit (LEO) environment in experiment AO134 on the Long Duration Exposure Facility is reported. The changes in mechanical properties of ultimate tensile strength and tensile modulus for exposed flight specimens are compared to the three sets of control specimens. Marked changes in surface appearance are discussed, and resin loss is reported. The chemical characterization including infrared, thermal, and selected solution property measurements showed that the molecular structure of the polymetric matrix had not changed significantly in response to this exposure. Author

N92-24843*# Aerospatiale, Les Mureaux (France). Space and Strategic Systems Div.
EFFECT OF SPACE ENVIRONMENT ON COMPOSITE MATERIALS AND THERMAL COATINGS (A0138-9) **c27**
Michel Parcelier and Jean Pierre Assie (Aerospatiale, Cannes, France) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1163-1173 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

This paper presents an experiment within the FRECOPA project on composite materials, adhesives, and thermal coatings. The aging of the specimens was limited because of the canister closing, the location on the trailing edge and the arrangement of the specimens inside the canister. The results show no evidence of change for several graphite fiber reinforced epoxy matrix composite materials as well as for two adhesives. Minor changes can be found on some second surface mirrors. Author

N92-24844*# MATRA Espace, Toulouse (France).
EFFECT OF SPACE EXPOSURE OF SOME EPOXY MATRIX COMPOSITES ON THEIR THERMAL EXPANSION AND MECHANICAL PROPERTIES (A0138-8) **c24**
Heinrich Jabs *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1175-1186 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11D

Assessments of the behavior of the carbon/epoxy composites in space conditions are described. After an exposure of five years, the mechanical characteristics and the coefficient of thermal expansion are measured and compared to reference values. Author

N92-24845*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
MECHANICAL PROPERTIES OF SILICATE GLASSES EXPOSED TO A LOW-EARTH ORBIT Abstract Only **c27**
David E. Wiedlocher, Dennis S. Tucker, Ron Nichols, and Donald L. Kinser (Vanderbilt Univ., Nashville, TN.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1187 (For primary document see N92-24806 15-99)
Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

The effects of a 5.8 year exposure to low earth orbit environment upon the mechanical properties of commercial optical fused silica, low iron soda-lime-silica, Pyrex 7740, Vycor 7913, BK-7, and the glass ceramic Zerodur were examined. Mechanical testing employed the ASTM-F-394 piston on 3-ball method in a liquid nitrogen environment. Samples were exposed on the Long Duration Exposure Facility (LDEF) in two locations. Impacts were observed on all specimens except Vycor. Weibull analysis as well as a standard statistical evaluation were conducted. The Weibull analysis revealed no differences between control samples and the two exposed samples. We thus concluded that radiation components of the Earth orbital environment did not degrade the mechanical strength of the samples examined within the limits of experimental

error. The upper bound of strength degradation for meteorite impacted samples based upon statistical analysis and observation was 50 percent. Author

N92-24846*# Air Force Geophysics Lab., Hanscom AFB, MA. Space Physics Div.

PATTERNS OF DISCOLORATION AND OXIDATION BY DIRECT AND SCATTERED FLUXES ON LDEF, INCLUDING OXYGEN ON SILICON **c27**

A. R. Frederickson, R. C. Filz, F. J. Rich, and P. L. Sagalyn (Army Materials Technology Lab., Watertown, MA.) *In* NASA. Langley Research Center, LDEF: 69 Months in Space. First Post-Retrieval Symposium, Part 2 Jan. 1992 p 1189-1199 (For primary document see N92-24806 15-99)

Avail: NTIS HC/MF A25; 2 functional color pages CSCL 11C

A number of interesting discoloration patterns are clearly evident on MOOO2-1 which resides on the three faces of the Long Duration Exposure Facility (LDEF). Most interesting is the pattern of blue oxidation on polished single crystal silicon apparently produced by scattered or direct ram oxygen atoms along the earth face. A complete explanation for the patterns has not yet been obtained. All honeycomb outgassing holes have a small discoloration ring around them that varies in color. The shadow cast by a suspended wire on the earth face surface is not easily explained by either solar photons or by ram flux. The shadows and the dark/light regions cannot be explained consistently by the process of solar ultraviolet paint-darkening modulated by ram flux oxygen bleaching of the paint. Author

N92-24987*# National Aeronautics and Space Administration, Washington, DC.

THE FEDERAL CONFERENCE ON INTELLIGENT PROCESSING EQUIPMENT

Apr. 1992 205 p Conference held in San Jose, CA, 3-5 Dec. 1991

(NASA-CP-3138; NAS 1.55:3138) Avail: NTIS HC/MF A10 CSCL 05I

Research and development projects involving intelligent processing equipment within the following U.S. agencies are addressed: Department of Agriculture, Department of Commerce, Department of Energy, Department of Defense, Environmental Protection Agency, Federal Emergency Management Agency, NASA, National Institutes of Health, and the National Science Foundation. For individual titles, see N92-24988 through N92-25001.

N92-24988*# Agricultural Research Service, Beltsville, MD. Product Utilization Div.

ADVANCED MANUFACTURING AND VALUE-ADDED PRODUCTS FROM US AGRICULTURE **c43**

Ruxton H. Villet, Dennis R. Child, and Basil Acock *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 13-19 (For primary document see N92-24987 15-99)

Avail: NTIS HC/MF A10 CSCL 02C

An objective of the US Department of Agriculture (USDA) Agriculture Research Service (ARS) is to develop technology leading to a broad portfolio of value-added marketable products. Modern scientific disciplines such as chemical engineering are brought into play to develop processes for converting bulk commodities into high-margin products. To accomplish this, the extremely sophisticated processing devices which form the basis of modern biotechnology, namely, genes and enzymes, can be tailored to perform the required functions. The USDA/ARS is a leader in the development of intelligent processing equipment (IPE) for agriculture in the broadest sense. Applications of IPE are found in the production, processing, grading, and marketing aspects of agriculture. Various biotechnology applications of IPE are discussed. K.S.

N92-24989*# National Inst. of Standards and Technology, Gaithersburg, MD. Manufacturing Engineering Lab.

INTELLIGENT PROCESSING EQUIPMENT RESEARCH AND DEVELOPMENT PROGRAMS OF THE DEPARTMENT OF COMMERCE **c63**

J. A. Simpson *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 20-31 (For primary document see N92-24987 15-99)

Avail: NTIS HC/MF A10 CSCL 09B

The intelligence processing equipment (IPE) research and development (R&D) programs of the Department of Commerce are carried out within the National Institute of Standards and Technology (NIST). This institute has had work in support of industrial productivity as part of its mission since its founding in 1901. With the advent of factory automation these efforts have increasingly turned to R&D in IPE. The Manufacturing Engineering Laboratory (MEL) of NIST devotes a major fraction of its efforts to this end while other elements within the organization, notably the Material Science and Engineering Laboratory, have smaller but significant programs. An inventory of all such programs at NIST and a representative selection of projects that at least demonstrate the scope of the efforts are presented. Author

N92-24990*# Department of Energy, Washington, DC.

US DEPARTMENT OF ENERGY'S EFFORTS IN INTELLIGENT PROCESSING EQUIPMENT **c63**

Richard D. Peavy and Janet C. McFarland (Meridian Corp., Alexandria, VA.) *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 32-54 (For primary document see N92-24987 15-99)

Avail: NTIS HC/MF A10 CSCL 09B

The Department of Energy (DOE) uses intelligent processing equipment (IPE) technologies to conduct research and development and manufacturing for energy and nuclear weapons programs. This paper highlights several significant IPE efforts underway in DOE. IPE technologies are essential to the accomplishment of DOE's missions, because of the need for small lot production, precision, and accuracy in manufacturing, hazardous waste management, and protection of the environment and the safety and health of the workforce and public. Applications of IPE technologies include environmental remediation and waste handling, advanced manufacturing, and automation of tasks carried out in hazardous areas. DOE laboratories have several key programs that integrate robotics, sensor, and control technologies. These programs embody a considerable technical capability that also may be used to enhance U.S. industrial competitiveness. DOE encourages closer cooperation with U.S. industrial partners based on mutual benefits. This paper briefly describes technology transfer mechanisms available for industrial involvement. Author

N92-24991*# Wright Lab., Wright-Patterson AFB, OH. Manufacturing Technology Directorate.

AN INTRODUCTION TO INTELLIGENT PROCESSING PROGRAMS DEVELOPED BY THE AIR FORCE MANUFACTURING TECHNOLOGY DIRECTORATE **c63**

Paul G. Sampson and Linda C. Sny *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 55-62 (For primary document see N92-24987 15-99)

Avail: NTIS HC/MF A10 CSCL 09B

The Air Force has numerous on-going manufacturing and integration development programs (machine tools, composites, metals, assembly, and electronics) which are instrumental in improving productivity in the aerospace industry, but more importantly, have identified strategies and technologies required for the integration of advanced processing equipment. An introduction to four current Air Force Manufacturing Technology Directorate (ManTech) manufacturing areas is provided. Research is being carried out in the following areas: (1) machining initiatives for aerospace subcontractors which provide for advanced technology and innovative manufacturing strategies to increase the capabilities of small shops; (2) innovative approaches to advance machine tool products and manufacturing processes; (3) innovative approaches to advance sensors for process control in

machine tools; and (4) efforts currently underway to develop, with the support of industry, the Next Generation Workstation/Machine Controller (Low-End Controller Task). Author

N92-24992*# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, NJ.
ARMY (MANTECH) THRUST AREA CONCEPT: OPTICS THRUST AREA **c31**
Stanley P. Kopacz *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 63-67 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

With the shrinking of the U.S. Army's material needs and the compression of defense requirements, the Army Manufacturing Technology (MANTECH) Program has the opportunity to advance the manufacturing state-of-the-art and solve near term production problems of the U.S. industrial base. To exploit this opportunity, the Army restructured its MANTECH efforts in FY 90 based on a thrust area concept. Each of the ten current thrusts, directed by a thrust area manager, has a broad technical objective selected to improve specific manufacturing processes. The manager is charged with setting objectives, selecting tasks, monitoring execution, leveraging external resources, and establishing microfactories to promote technology transfer. The Optics Manufacturing Thrust is an example of the concept. It is currently directed at revitalizing the domestic precision optics manufacturing base, now characterized by high labor costs and 1940's technology, through introduction of revolutionary machines, new processes, and Computer Integrated Manufacturing (CIM) principles. Leveraging of MANTECH dollars with those of industry, academia, and state governments led to the establishment of the center for Optics Manufacturing and plans for regional centers. Recognition of the U.S. as a world leader in precision optics manufacturing and a dramatic reduction of both manufacturing time and cost should accrue from thrust area efforts. Author

N92-24993*# National Inst. of Standards and Technology, Gaithersburg, MD.
INTELLIGENT PROCESSING EQUIPMENT DEVELOPMENTS WITHIN THE NAVY'S MANUFACTURING TECHNOLOGY CENTERS OF EXCELLENCE **c31**
Philip Nanzetta *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 68-73 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

The U.S. Navy has had an active Manufacturing Technology (MANTECH) Program aimed at developing advanced production processes and equipment since the late-1960's. During the past decade, however, the resources of the MANTECH program were concentrated in Centers of Excellence. Today, the Navy sponsors four manufacturing technology Centers of Excellence: the Automated Manufacturing Research Facility (AMRF); the Electronics Manufacturing Productivity Facility (EMPF); the National Center for Excellence in Metalworking Technology (NCEMT); and the Center of Excellence for Composites Manufacturing Technology (CECMT). This paper briefly describes each of the centers and summarizes typical Intelligent Equipment Processing (IEP) projects that were undertaken. Author

N92-24994*# Defense Logistics Agency, Alexandria, VA. Manufacturing Engineering Branch.
INTELLIGENT PROCESSING EQUIPMENT PROJECTS AT DLA **c31**
Donald F. OBrien *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 74-77 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

The Defense Logistics Agency is successfully incorporating Intelligent Processing Equipment (IPE) into each of its Manufacturing Technology thrust areas. Several IPE applications are addressed in the manufacturing of two 'soldier support' items: combat rations and military apparel. In combat rations, in-line sensors for food processing are being developed or modified from other industries. In addition, many process controls are being automated to achieve better quality and to gain higher use (soldier) acceptance. IPE applications in military apparel include: in-process quality controls for identification of sewing defects, use of robots in the manufacture of shirt collars, and automated handling of garments for pressing. Author

N92-24995*# Strategic Defense Initiative Organization, Washington, DC. Producibility and Manufacturing Div.
SDIO PRODUCIBILITY AND MANUFACTURING INTELLIGENT PROCESSING PROGRAMS **c31**
Greg Stottlemyer *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 78-89 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

SDIO has to fashion a comprehensive strategy to insert the capability of an industrial base into ongoing design tradeoffs. This means that there is not only a need to determine if something can be made to the precision needed to meet system performance, but also what changes need to be made in that industry sector to develop a deterministic approach to fabrication precision components. Developing and introducing advanced production and quality control systems is part of this success. To address this situation, SDIO has developed the MODIL (Manufacturing Operations Development and Integration Labs) program. MODILs were developed into three areas: Survivable Optics, Electronics and Sensors, and Spacecraft Fabrication and Test. Author

N92-24996*# IIT Research Inst., Chicago, IL. Manufacturing Technology Information Analysis Center.
MANUFACTURING TECHNOLOGY INFORMATION ANALYSIS CENTER: KNOWLEDGE IS STRENGTH **c31**
Michal Safar *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 90-94 Sponsored by DOD (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

The Center's primary function is to facilitate technology transfer within DoD, other government agencies and industry. The DoD has recognized the importance of technology transfer, not only to support specific weapon system manufacture, but to strengthen the industrial base that sustains DoD. MTIAC uses an experienced technical staff of engineers and information specialists to acquire, analyze, and disseminate technical information. Besides ManTech project data, MTIAC collects manufacturing technology from other government agencies, commercial publications, proceedings, and various international sources. MTIAC has various means of disseminating this information. Much of the technical data is on user accessible data bases. The Center researches and writes a number of technical reports each year and publishes a newsletter monthly. Customized research is performed in response to specific inquiries from government and industry. MTIAC serves as a link between Government and Industry to strengthen the manufacturing technology base through the dissemination of advanced manufacturing information. Author

N92-24997*# Environmental Protection Agency, Cincinnati, OH. Risk Reduction Engineering Lab.
INTELLIGENT PROCESSING EQUIPMENT WITHIN THE ENVIRONMENTAL PROTECTION AGENCY **c45**
Daniel G. Greathouse and Richard P. Nalesnik (Environmental Protection Agency, Washington, DC.) *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 95-101 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13B

Protection of the environment and environmental remediation requires the cooperation, at all levels, of government and industry. Intelligent processing equipment, in addition to other artificial intelligence based tools, was used by the Environmental Protection Agency to provide personnel safety and improve the efficiency of those responsible for protection and remediation of the environment. These exploratory efforts demonstrate the feasibility and utility of expanding development and widespread use of these

tools. A survey of current intelligent processing equipment applications in the Agency is presented and is followed by a brief discussion of possible uses in the future. Author

N92-24998*# South Carolina Research Authority. Charleston.
RAMP TECHNOLOGY AND INTELLIGENT PROCESSING IN SMALL MANUFACTURING **c31**
Richard E. Rentz *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 102-124 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

To address the issues of excessive inventories and increasing procurement lead times, the Navy is actively pursuing flexible computer integrated manufacturing (FCIM) technologies, integrated by communication networks to respond rapidly to its requirements for parts. The Rapid Acquisition of Manufactured Parts (RAMP) program, initiated in 1986, is an integral part of this effort. The RAMP program's goal is to reduce the current average production lead times experienced by the Navy's inventory control points by a factor of 90 percent. The manufacturing engineering component of the RAMP architecture utilizes an intelligent processing technology built around a knowledge-based shell provided by ICAD, Inc. Rules and data bases in the software simulate an expert manufacturing planner's knowledge of shop processes and equipment. This expert system can use Product Data Exchange using STEP (PDES) data to determine what features the required part has, what material is required to manufacture it, what machines and tools are needed, and how the part should be held (fixtured) for machining, among other factors. The program's rule base then indicates, for example, how to make each feature, in what order to make it, and to which machines on the shop floor the part should be routed for processing. This information becomes part of the shop work order. The process planning function under RAMP greatly reduces the time and effort required to complete a process plan. Since the PDES file that drives the intelligent processing is 100 percent complete and accurate to start with, the potential for costly errors is greatly diminished. Author

N92-24999*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
ASSESSMENT OF INTELLIGENT PROCESSING EQUIPMENT IN THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, 1991 **c31**
C. S. Jones *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 125-164 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

Summarized here is an assessment of intelligent processing equipment (IPE) within NASA. An attempt is made to determine the state of IPE development and research in specific areas where NASA might contribute to the national capability. Mechanisms to transfer NASA technology to the U.S. private sector in this critical area are discussed. It was concluded that intelligent processing equipment is finding extensive use in the manufacture of space hardware, especially in the propulsion components of the shuttle. The major benefits are found in improved process consistency, which lowers cost as it reduces rework. Advanced feedback controls are under development and being implemented gradually into shuttle manufacturing. Implementation is much more extensive in new programs, such as in the advanced solid rocket motor and the Space Station Freedom. Author

N92-25000*# National Inst. of Health, Bethesda, MD. Office of Science Policy.
NATIONAL INSTITUTES OF HEALTH PRESENTATION AT IPE CONFERENCE PROGRAM **c51**
Caroline Holloway *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 165-175 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 06A

The conference objective was to set up a working dialogue among representatives from industry and various Federal agencies. Discussed here are present National Institutes of Health (NIH) support in the area of intelligent processing equipment (IPE) and how researchers can work together on future research objectives. Information is given in viewgraph form with accompanying comments. Author

N92-25001*# National Science Foundation, Washington, DC. Div. of Design and Manufacturing Systems.
INTELLIGENT PROCESSING EQUIPMENT RESEARCH SUPPORTED BY THE NATIONAL SCIENCE FOUNDATION **c31**
Suren B. Rao *In* NASA, Washington, The Federal Conference on Intelligent Processing Equipment Apr. 1992 p 176-187 (For primary document see N92-24987 15-99)
Avail: NTIS HC/MF A10 CSCL 13H

The research in progress on processes, workstations, and systems has the goal of developing a high level of understanding of the issues involved. This will enable the incorporation of a level of intelligence that will allow the creation of autonomous manufacturing systems that operate in an optimum manner, under a wide range of conditions. The emphasis of the research has been on the development of highly productive and flexible techniques to address current and future problems in manufacturing and processing. Several of these projects have resulted in well-defined and established models that can now be implemented in the application arena in the next few years. Author

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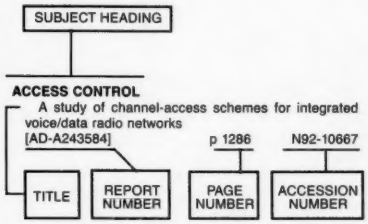

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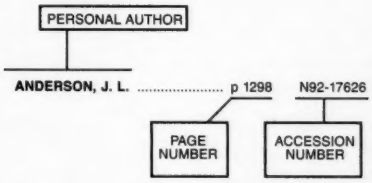

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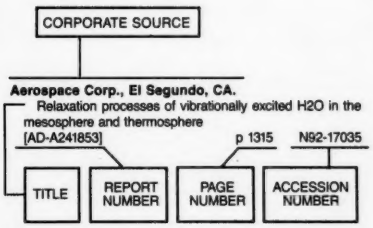

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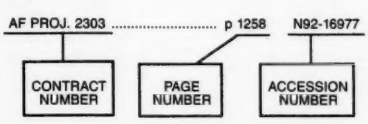

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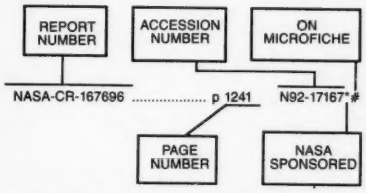

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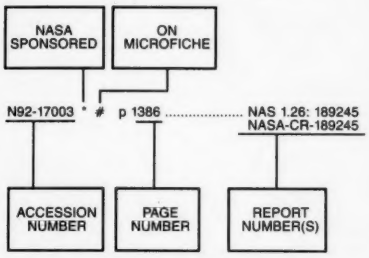

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